# the Petroleum Engineer

FOR MANAGEMENT

INTEGRATED EDITION OF THE PETROLEUM ENGINEER



Outlook for 1957 — A Record Breaker

Company Engineers Handle Most Problems

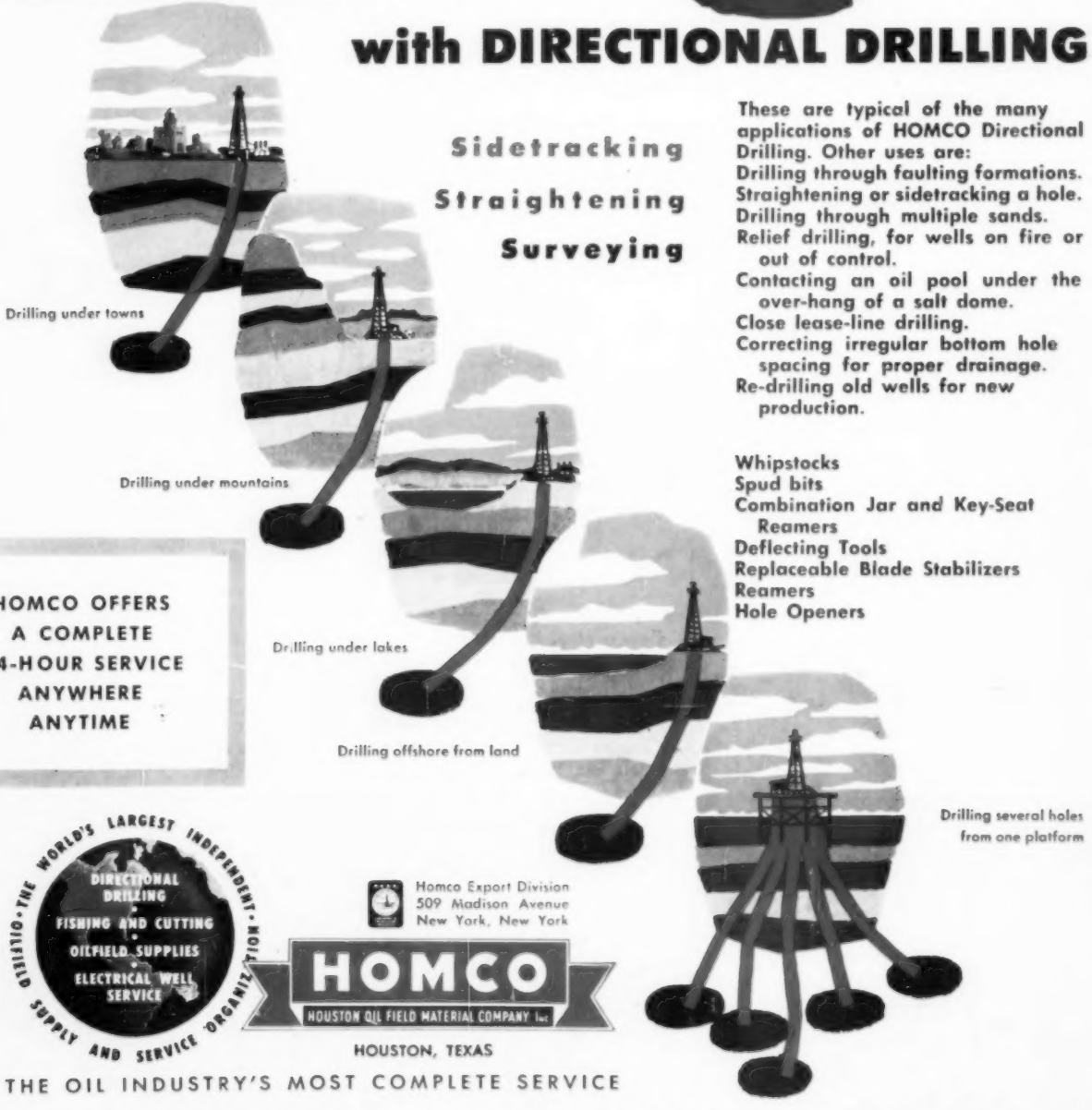
New Processing Plant Construction

1957 Pipe Line Outlook: Could Be Industry's Greatest Year



HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY, Inc.

hits the spot with DIRECTIONAL DRILLING



Drilling under towns

Drilling under mountains

Drilling under lakes

Drilling offshore from land

Drilling several holes from one platform

Sidetracking

Straightening

Surveying

These are typical of the many applications of HOMCO Directional Drilling. Other uses are:
Drilling through faulting formations.
Straightening or sidetracking a hole.
Drilling through multiple sands.
Relief drilling, for wells on fire or out of control.
Contacting an oil pool under the over-hang of a salt dome.
Close lease-line drilling.
Correcting irregular bottom hole spacing for proper drainage.
Re-drilling old wells for new production.

Whipstocks
Spud bits
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Deflecting Tools
Replaceable Blade Stabilizers
Reamers
Hole Openers

HOMCO OFFERS A COMPLETE 24-HOUR SERVICE ANYWHERE ANYTIME

THE WORLD'S LARGEST INDEPENDENT OILFIELD SUPPLY AND SERVICE ORGANIZATION

DIRECTIONAL DRILLING • FISHING AND CUTTING • OILFIELD SUPPLIES • ELECTRICAL WELL SERVICE

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HOMCO
HOUSTON OIL FIELD MATERIAL COMPANY Inc.

HOUSTON, TEXAS

THE OIL INDUSTRY'S MOST COMPLETE SERVICE

RESEARCH • DEVELOPMENT • ENGINEERING • MANUFACTURING



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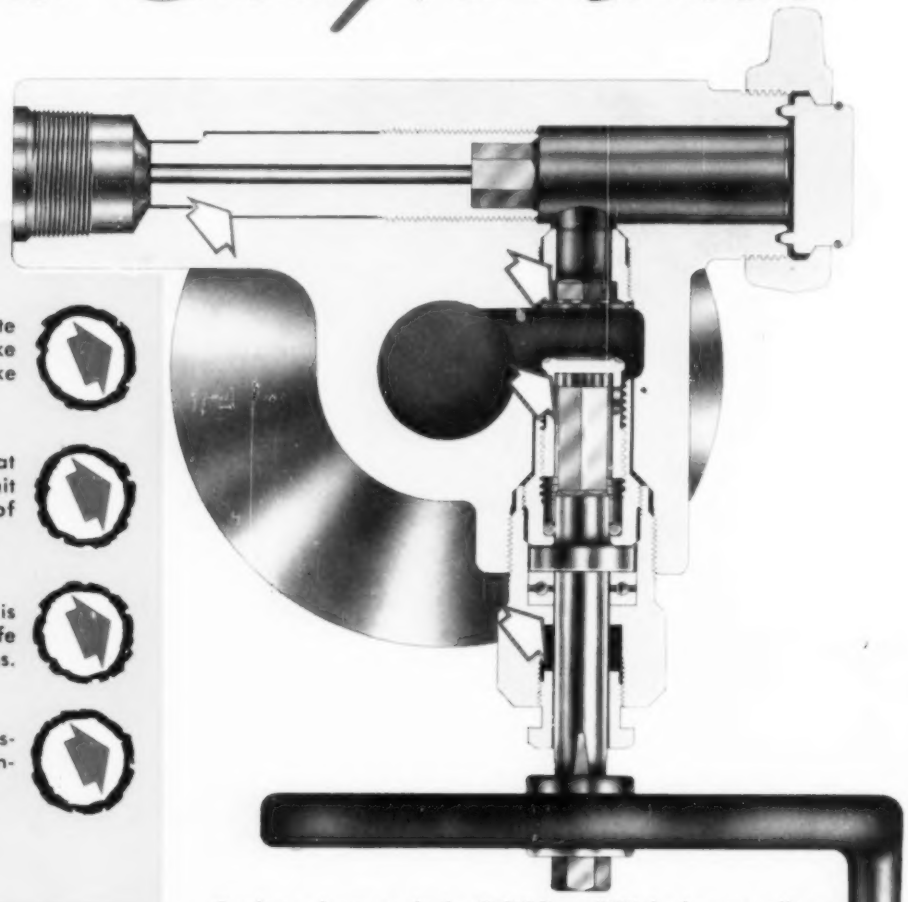
JANUARY 1957 One Dollar A Copy

# Here's why the O·C·T "JE" is the *Largest Selling Flow Control*



Body can accommodate any size positive choke to 1" or adjustable choke up to ¾" opening.

Hard faced 1" valve seat is replaceable to permit complete renewal of valve in five minutes.

True valve-type gate is hard-faced for long life under severe conditions.

Ball thrust bearing assures easy operation under highest pressures.

Producers have made the O-C-T Type "JE" the largest selling flow control because it helps them reduce both first cost and maintenance expense. It is the only flow control on the market that gives you the advantage of both a choke and a true valve-type gate assembly and seating arrangement.

The O-C-T type "JE" Flow Control is available through any Christmas tree manufacturer or through more than 700 supply store locations.

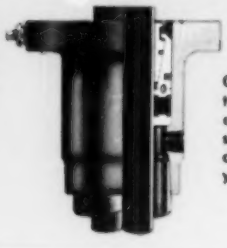
**O·C·T**

**OIL CENTER TOOL CO.**

P. O. Box 3091, Houston, Texas

Export Representatives: Sterling Areas — Le Grand, Sutcliff & Gell, Ltd., Rochester, Kent, England. South America—East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

*No casing string too long . . .*



The O-C-T C-19 Casing head can support the longest strings with complete safety. It is the safest, most economical deep well casing head you can buy.

1882 — 1957

*The appreciation of our many customers throughout the years for quality, dependability and service of Norris Products has made possible this 75th Anniversary.*

# W.C. NORRIS MANUFACTURER, INC.

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*A Magazine of Petroleum Management*

# the Petroleum Engineer

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We have no more right to consume happiness without producing it, than to consume wealth without producing it.

— *George Bernard Shaw*

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U. S. products demand up about 5 per cent
Crude oil prices to keep edging up
Nation's economic health in good shape
Middle East crisis spotlights industry's role
$4 billion highway building program in works

— *Ernestine Adams*

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— *Carl W. Barkow*

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## Escalation — the One-Lane Principle

When the last living standard price index was released by the U. S. government, millions of dollars were added to the wages of thousands of workers as the result of an escalation clause in the union contract. The contract calls for automatic wage increases to meet higher costs of living.

Management has agreed to this escalation clause in order to obtain union contracts for more than one year. Recent contracts have called for specific wage increases each year for two, three, or more years in return for contracts running the same period for union workers.

These contracts have the evident approval of labor, management, the Federal government. If there is any objection by consumers it is very quiet and unorganized. Yet they must pay the added cost on products made under escalation wage contracts which makes no provision for increased producing efficiency.

Is what is good for union labor bad for gas producers? Is an escalation clause a one lane highway on which only union labor can travel? Is it fair that a union leader can demand and get an automatic increase each year in a three-year contract when a gas producer, who often must take a 20-year contract or none, should not get an escalation clause?

The new year will bring a new effort to release natural gas producers from Federal control. One of the chief targets of those for price control is the "favored nation" and escalation clauses in gas sales contracts. The producer earns his income from the gas he has discovered and developed as surely as the wage-earner earns his from his skill.

It is said that in its annual report, the Federal Power Commission will again ask Congress to exempt independent natural gas producers from federal price controls. The present situation is a headache for FPC and has become impossible for many producers.

But even these reports signify that some substitute will be suggested for escalation clauses. What — we don't know. We do believe that in an economy as future-planned as the oil and gas industry is, we cannot afford to have production swallowed by eroding inflation.

Escalation should be a broad highway with space for any contract or it should be closed.

*Ernestine Adams.*

***NO. 1 PROBLEM***

*"Human relations is the number one problem of the twentieth century on a personal, national, and international basis."*

*So stated Ben Wooten, president of the First National Bank of Dallas, Texas.*

*We have gone far ahead scientifically and industrially. We cannot pause in our technological progress to allow human relations to catch ug but we can work faster and more intensely in that vital area of civilization.*

*It may be that clesses in human relations should begin like arithmetic in the first grade—not informally as it is now but with a formal study giving school credit. Most students don't realize until they are in the working world that it is more important to believe in and understand the energy of man than of the atom.*

Here's how you can get

# MORE EFFICIENT OIL RECOVERY from your flooding operations:

## INSIST upon these standards for your flooding medium

1. **Chemical stability**
2. **Oil content zero**
3. **Iron content 0.2 parts per million**
4. **Turbidity 1 part per million**

Most operators agree that these standards for the flooding medium (water, produced brine, or both) are necessary for minimizing clogging of the input formation. INFILCO *complete* treating plants, which include the highly efficient ACCELATOR® Stabilizer, provide water within the specified limits. Closed systems, or other types of partial treatment, seldom meet these exacting requirements.

Existing INFILCO installations are treating over 500,000 barrels per day with three-way economy: lower first cost, lowest maintenance and low, low chemical costs. INFILCO engineers have over 30 years experience in designing *complete* flooding water treatment plants. Be sure you are getting maximum oil recovery by consulting your nearby INFILCO engineer. If you prefer, write for complete information.

Typical INFILCO flooding water treatment plant includes: Forced Draft Aerators; "ACCELATOR" Treating Plants; Chemical Feeders and INFILCO Pressure Filter Plant.

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**INCORPORATED**
*General Offices • Tucson, Arizona • P.O. Box 5033*

*Field offices throughout the United States and in foreign countries*

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THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS — THE PUBLISHER ASSUMES NO RESPONSIBILITY FOR ERRORS OR OMISSIONS

# 41 OUT OF THE LAST 41

## ...and there are good reasons why every one's an "OILWELL"

**LION OIL COMPANY,** a division of Monsanto Chemical Company, recently installed 41 "Oilwell" Pumping Units in its Cottage Grove field, 25 miles northeast of Shreveport, Louisiana.

Six of the first-equipped wells in this field are pumped by 12-G-12 units, having polished rod load capacities of 10,600 or 11,300 lbs.

The remaining 35 units are 9-A-9's with 9,000 lb. polished rod load capacity and a stroke length range from 24⅛" to 38". They are powered by "98RC" Witte engines and are currently operating at about 16 strokes per minute; handling production from approximately 2,000 feet with ⅝" rod strings and 1½" subsurface pumps. This size unit achieves accurate counterbalancing with slab-type counterweights on the extended walking beam and is extremely economical to buy, install, and operate.

Heavy structural-steel base, with wide-spaced, four-legged, derrick-type samson post, eliminates maintenance problems encountered in units of less rigid construction. The advantages of standardization are obvious. One man with a grease gun can grease-pack every pumping-unit-frame bearing (equalizer bearing, saddle and wrist-pin bearings) in a matter of minutes.

**Let an "Oilwell" Representative . . .** help you standardize on pumping units that will give you the most economical service throughout the producing life of your field.

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**DIVISION**
**UNITED STATES STEEL CORPORATION**

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*Branches Serving All Oil Fields*

USS TRADE MARK

# "OILWELL"

TRADE MARK

UNITED STATES STEEL

# Petroleum Profile

**HAROLD DECKER**

*President*

*Highland Oil Company*

WHEN Professor George went west from Pittsburgh University in 1923 and set up the first petroleum engineering course at the University of Oklahoma, he had two eager young men ready for him. They were going to be engineers in the booming oil industry.

Both of them were engineers for years before they turned to executive duties and engineering became a useful background. The two were Harold Decker, recently president of Houston Oil Company of Texas and now president of Highland Oil Company, and George L. Nye, senior vice president of First City National Bank of Houston.

Harold Decker had been working in the oil fields before he went to Oklahoma University. He'd graduated from Guthrie, Oklahoma, high school, and had gone to Kenyon College at Gambier, Ohio, on a scholarship for a year.

He came back and the next year entered the University of Oklahoma as a student in civil engineering. In his sophomore summer he went to work for Empire Oil (Cities Service) as a roustabout in the Burbank field. In the fall of 1923 he entered the first petroleum engineering school at the University and remained there until 1925.

Some people stay in one company and take their progress step by step. Harold Decker went from company to company gathering experience, making friends, and developing a good brand of leadership. He marched through the depression like a man going places—which he was.

Decker's easy and sure climb in the petroleum industry was no surprise to anyone. He is natural born management type and that kind is scarce. Several companies he worked for had him on the list as a future official. In 1949 when he was with Pan American, he attended the Advanced Management Program of Harvard University Graduate School of Business Administration in Boston, Massachusetts.

When he left Oklahoma University, Decker took a job under John Suman doing roughnecking in the Texas Gulf Coast with Rio Bravo Oil Company. About that time Marland Oil Company set up an engineering department, a rare division in those days, and offered him a place in it. He turned his back on drilling crews and joined the company, proud to be in a petroleum engineering department. One of his first assignments gave the young engineer great satisfaction. He was sent to Coffeyville, Kansas, on a production research job dealing with what was then a new-fangled airlift and repressuring project. The scientist was in business! To make things even busier, he began courting the future Mrs. Decker, Jessica McGinnis.

In 1929 friends in Tidal Oil Company were able to persuade Harold to come with them. He stayed only a year with Tidal, then went with Skelly. In the depression year Skelly's J. R. McWilliams sent him to Seminole where he claims he was clerk, superintendent, and general hustler. Shortly afterwards he was transferred to Texas.

Evidently Skelly management thought he did all right in these varied roles because he was sent to the Texas Gulf Coast in 1932 as division superintendent to develop the company's first field in the area, the Bay City field.

Decker spent five years in Houston with Skelly before resigning in 1937 to become division superintendent for Seaboard Oil Company with headquarters at Corpus Christi. This turned into a multiple job, too, for he took on the land and geological departments also. The job and the place suited him but he couldn't turn down the offer in February, 1945, when he was asked to become assistant manager of Pan American Production Company and Pan American Gas Company. In two years he'd proved himself and was promoted to vice president and general manager and a member of the boards of directors of the two companies.

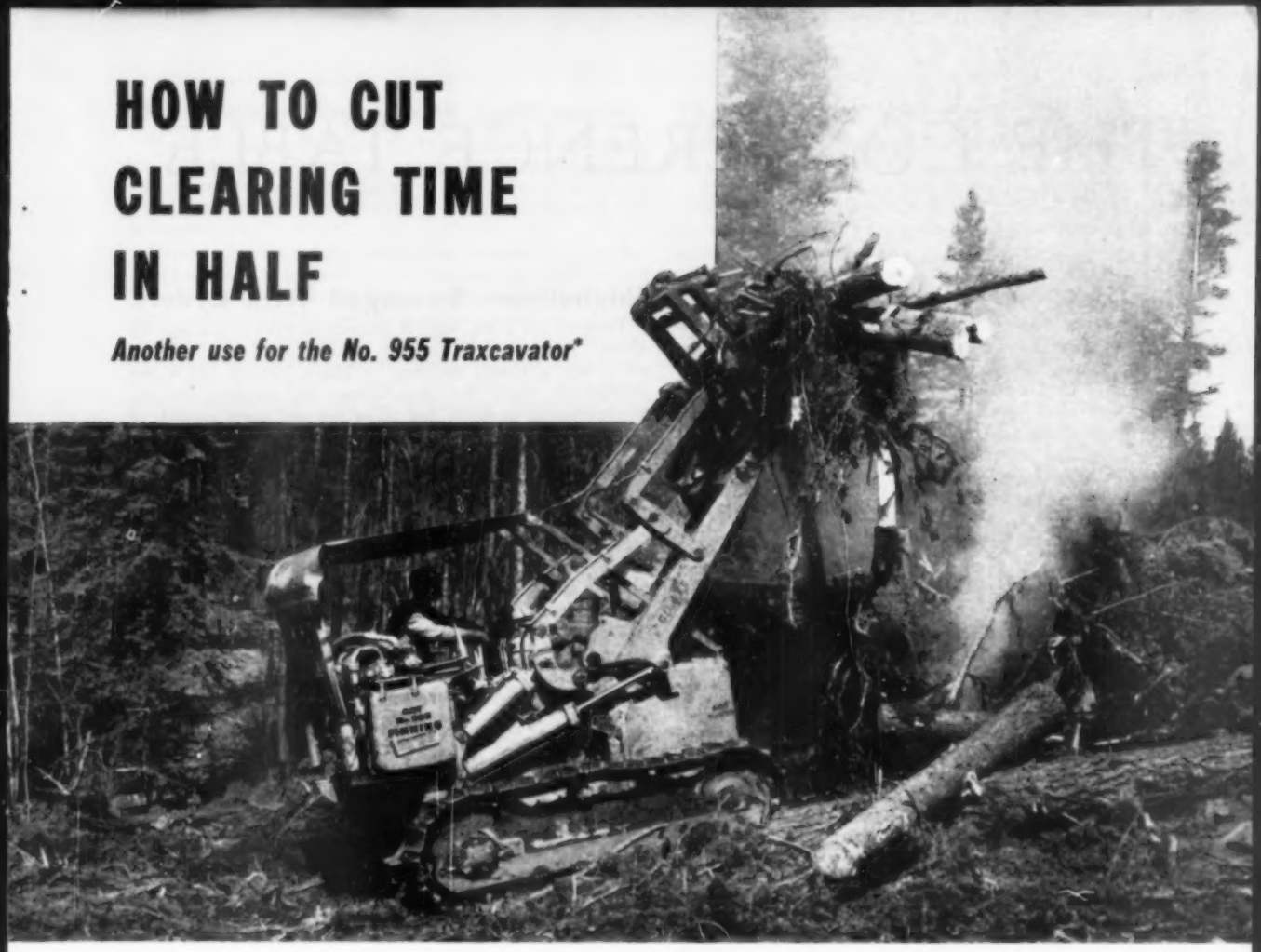
The first presidency came January 1, 1950, when Harold Decker was named head man of Houston Oil Company of Texas and its subsidiaries, Houston Pipe Line Company and Southwestern Settlement and Development Corporation. From then until this year when Atlantic Refining bought the oil and pipe line companies and Time, Inc., bought Southwestern, Decker guided the destinies of the companies, which in 1955 grossed more than $37 million. There were two apparent reasons for the sale—the big risk and high cost of building up oil and gas reserves and the fact that the offers were considered fair. The companies were sold and liquidated bringing stockholders $226 million gross, more than $166 a share.

Instead of remaining in a large corporation, Mr. Decker became associated with Herman and George Brown in Brown & Root's oil division. He is manager of all of the partnership's oil interests and is also president of Highland Oil Company, a fully owned subsidiary.

Like all top industry men, here is another who works with associates for common progress. He belongs to IPAA, Mid-Continent Oil & Gas Association, AIME, API, Houston Club, Dallas Petroleum Club and other organizations. He is the kind of person you like to have around so he has been or is an officer in nearly all his affiliations.

# HOW TO CUT CLEARING TIME IN HALF

***Another use for the No. 955 Traxcavator****



Conyes Construction Corp., San Pablo, Calif., is using six Caterpillar No. 955 Traxcavators to clear 210 miles of pipeline right-of-way in British Columbia. The company estimates that these Cat-built units *are cutting clearing time in half.* Here's how:

To cut a 60-foot-wide path through jack pine and fir, a D8 knocks down the trees. Everything over eight inches is salvaged by a crew. Then the No. 955s, equipped with alligator jaws operated with a hydraulic ram, pile the logs along the right-of-way and the remaining material on brush fires. The Traxcavators are even used to accelerate the fires. The units lift the top of the pile and use their blower-type engine fans to get a hot fire going quickly.

This method of clearing has enabled Conyes to average one-half to three-quarters of a mile per day in rough going—even working in 10 to 20 inches of snow!

The No. 955 is the newest Caterpillar-built equipment for pipeline spreads. Worked with alligator jaws, general purpose bucket, skeleton rock bucket, or bulldozer blades, this versatile unit enables you to pioneer roads, clear, backfill, build equipment sites and storage yards, and load trucks.

There are three sizes of Caterpillar-built Traxcavators—the No. 933, the No. 955 and the No. 977. They range in size from one-yard to 2¼-yard capacity, and, like all CAT* pipeline equipment, are designed to stay on the job.

Wherever the pipe takes you, you always are near fast, efficient Caterpillar service with factory parts that you can trust. So see your Caterpillar Dealer soon. He'll demonstrate these big, versatile machines on your job . . . at your convenience.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

**CATERPILLAR***

*Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

**NAME THE DATE . . .
YOUR DEALER
WILL DEMONSTRATE**

# THE CONFERENCE TABLE

*We have no more right to consume happiness without producing it, than to consume wealth without producing it.* — GEORGE BERNARD SHAW

## MEEC Motives Spelled Out

All segments of the U. S. petroleum industry will be represented in operations of the Middle East Emergency Committee, so stated Defense Mobilizer Flemming. Committee formed by 15 U. S. oil companies to help meet Europe's fuel shortage will have various representatives of the industry sitting in on discussions. Interior Secretary Seaton names these motives and objectives of MEEC:

The government has no authority to control prices in the oil-for-Europe program and the industry, itself, must be fully aware of and is responsible for the effects of any price changes it makes.

The industry shall handle the problem to the maximum extent with the least government interference possible.

There "must not" be any domestic oil shortages.

Every effort will be made to minimize the effects of the program on the domestic industry.

The federal government will not encroach on states' rights, but will rely on cooperation and support of the oil regulatory bodies of the states.

## Varied Reactions to 1957

Interesting and sometimes original ideas of what the next year will bring begin on Page A-22, "Outlook for 1957 — A Record Breaker."

Every authority quoted had a different approach and a little different reasoning. The varied facets of recent events are studied carefully. Prospects for business are weighed with long and significant experience on the part of the industry leaders. The comments hold a wealth of information.

**Assistant reporting to president:** "Our workers think a guaranteed annual wage is fine, and a guaranteed bonus, and a guaranteed pension plan. But, chief. what they want most of all is a guarantee you won't go broke."

## Shipbuilders Swamped With Orders

Tankers are a big subject nowadays. Five years ago we wrote, "Tankers saved the day in 1951 when an oil-hungry world was suddenly deprived of Iran's 700,000 bbl a day production." Again this year, tankers are stepping into the transportation problem but there are not quite enough of them.

There is a rush to the shipyards in the U. S. and Europe for new supertankers, the kind that can sail around the Cape of Good Hope. Only limit appears to be the difficulty of obtaining enough steel plate.

Orders are somewhat startling. U. S. shipyards are building about 40 new large tankers, up to 100,000 tons each and Europe and Japan have orders that will keep them busy throughout the next few years. Gulf Oil alone ordered tankers in 1956 worth $100,000,000.

## Starting Engineering Salaries Up

Engineering graduates in 1957 will face better job prospects than any class before them. Some 24,000 firms are expected to absorb the approximately 26,000 engineers who will be graduating throughout the country next year. In the opinion of Freeman Stallings, graduate placement co-ordinator of Southern Methodist University, engineering salaries will start at about $470 per month.

This has its disadvantages though, Stallings said. An engineer can reach a plateau in a fairly short time and then become stable in his field. From this stems much of the dissatisfaction of the engineer who has been working 5 to 15 years. In his opinion, most personnel managers feel that those trained for the scientific field are not schooled along management lines and cannot advance accordingly. He is speaking of industry in general and in most respects this does not apply to the petroleum engineer who permeates the management level.

### Back to School for the Profs

Following a three-day, intensive short course in the programming and coding of electronic computers, 14 professors from the University of Oklahoma recently visited the computer installation in the Bartlesville, Oklahoma, offices of Phillips Petroleum Company's research and development department for a one-day program on the applications and operation of computers. An electronic computer was installed in OU's numerical analysis and computer laboratory.

The course was conducted at OU by Dr. M. R. Tek and Glenn Parker, of Phillips, who are shown, left, with some of the visiting professors in the computer room: Professor J. E. Powers and Associate Dean C. M. Sliepcevich of OU; Dr. Tek; Professor R. L. Biesele of OU; L. W. Pollock, manager of Phillips mathematical engineering branch, and Parker.

## Oversupply Seen With Settlement

W. M. Vaughey, chairman of the executive committee of the Independent Petroleum Association of America, and others are warning the industry to get ready for return to world markets of Near East oil. Vaughey released this statement:

"Now and in the coming months the domestic industry has an opportunity to prepare for the time when Middle East oil is again threatening the U. S. market. Clearance of the Suez Canal and repair of Middle East pipe line damage could mean an abrupt return to pre-Suez movements of Middle East oil. This unquestionably will require good judgment and caution on the part of the entire industry, both domestic and foreign, or the consequence could be oversupply conditions even worse than existed before the Suez dispute.

"The Middle East situation has clearly emphasized the necessity of giving first consideration to maintaining a sound oil producing industry in this country. As we look to 1957, I believe our government has a clear-cut responsibility to implement policies which will prevent imports from again reaching such excessive levels as existed before the disruption of Middle East supplies. Only under such a policy can the domestic industry realize a stability which will assure expansion of domestic oil supplies on a scale required to assure our future defense and essential civilian supplies."

## Only Productivity Creates Wages

Rising costs constitute the chief problem of petroleum industry management. Higher steel prices and higher prices for fabricated products are tied to rising wages all along the line. In February, 1956, most contracts with the Oil Chemical and Atomic Workers International Union saw a six per cent general wage increase with a 15-cent hourly minimum. Bargaining committee of the union has already announced that in 1957 it will ask a 27-cent per hour increase in wages for its 105,000 members in the oil industry.

Among the reasons given for this demand are "cost of living increases, productivity increases in the oil industry, wage and fringe benefit improvements won by union in other industries, and fantastic and constant increase in profits being enjoyed by companies."

There may be some justification for the first mentioned factors but the last, "fantastic and constant increase in profits" shows not only ignorance of petroleum economics but suggests that companies themselves should do a thorough job of economic education to offset this type of propaganda.

The only solid approach to increased wages and salaries is an increase in productivity. This means more output in the same period of time. One reason we are buying less this year for our money is that productivity gains have apparently fallen short of wage increases.

## Governor Gary Heads Compact

Chairman of the Interstate Oil Compact Commission for 1957 is Oklahoma Governor Raymond Gary. Serving with him as first and second vice chairmen will be Clarence T. Smith, representative from Illinois, and J. P. Jones, Pennsylvania representative. Judge Earl Foster was again selected executive secretary, an office he has held since 1944.

## The Engineer and Progress

Progress... Progress... Up the standards of living, cut the work week, build a better world...

The world seems to look at the engineer of today as they looked at the witch doctor of yesterday. They think anything and everything that can be achieved, will be achieved by engineering and science. The engineer is watched with a feeling of awe and dread, for the people think, "What will his next invention do to me? Will it take away my job, destroy my home, kill my family; or will it create new jobs, and perhaps keep peace on earth?"

This attitude places loads on the engineer of today and tomorrow. He must not only be an engineer, but also a politician, economist, author, psychologist, philosopher, and sociologist. The engineer faces tremendous problems in the application of advances such as automation and atomic energy. Not just technical problems, but also the involved social problems. Once the engineer was just the person who made the machinery work, but now he is a leader with a social responsibility to the world. Someone has to lead the way, convince the people that progress is good, ease the fears which all people get when confronted with something new and threatening.

It seems that now, more than ever before, the engineer should be receiving a well rounded education. The only trouble is that this is not so. The liberal arts are slowly being pushed out of the engineering curriculum. An engineer has so much to learn about his field that he can't spare time to learn how to live with the world. At least he can't under the present system. Maybe sometime our educators will find out that if they would take a little more time and give the engineering student a more rounded education, we would have a better engineer and a better citizen for a better world — R. R. B.

An Editorial in the *Georgia Tech Engineer*

## Annual Report Deluxe

One of the most beautiful books to come over our desk is the 1955 report of Ente Nazionale Indrocarburi. The format, the pictures, the graphs, the cover — everything in the volume is a triumph of publication.

The operational data of ENI are included in simple direct statements and figures. The photos, both black and white and color, are among the best we have seen. The reproductions of water color are very effective illustrations.

The 103-page, hard cover volume is worthy of a spot in anybody's library. Copies are not for sale, of course, but you might write The Italian Economic Corporation, 1 Wall Street, New York 5, New York, and perhaps you'll be lucky enough to get one.

## Taxpayers vs Tax Eaters

Private utility companies, both gas and electric, have good records of community support. It is time they found a wider audience.

Kinsey M. Robinson, president of Washington Water Power Company, drew up this comparison for Washington State:

| | |
|---|---|
| Public utility districts paid in taxes per customer | $12.25 |
| Private utilities paid in taxes per customer | $39.55 |
| Difference per customer | $27.30 |

*And the rates of private utilities are as low (or lower) than those of government-owned utilities.*

# HIGHLIGHTS ★ ★ ★

## *Digest of News and Comment*

**Oil industry research now involves** 15,000 persons, according to figures presented in the American Petroleum Institute's new Information Bulletin No. 14. The study pointed out that the industry spent more than $150,000,000 on research and development last year. This expense was broken down by the API, giving 52 per cent of the total amount to develop new products and/or processes, 37 per cent for product and process improvement, and 11 per cent to fundamental research.

★ ★ ★

**Tulsa, Oklahoma, has been** picked as the site of the 1957 annual meeting of the Interstate Oil Compact Commission, at the invitation of Oklahoma Governor Raymond Gary. Date has been set for December 2-4, and will coincide with the state's semi-centennial observance. This will be the first time the Commission has met in Tulsa since 1946.

★ ★ ★

**Oil and gas law will be studied** at two events in January at the Southwestern Legal Center in Dallas, Texas. A short course on such law will be offered January 3-29, 1957, and the eighth annual Institute of Law on Oil and Gas and Taxation has been scheduled January 30 through February 1. Both events are sponsored by the Southwestern Legal Foundation in cooperation with the Southern Methodist University School of Law.

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**Oil Industry Information Committee** 1957 budget of $2,612,910 has been approved by the board of directors of the American Petroleum Institute. The budget for the coming year was trimmed by $582,090 from the 1956 total. Bulk of the decrease is due to a reduction of the API's advertising program for 1957, to be confined to jobber-dealer and trade publications.

★ ★ ★

**Crude and product pipe line** deficiencies, as interpreted by the Texas Independent Producers and Royalty Owners, brought out in a recent hearing before the Texas Railroad Commission, has led the group "to press for a comprehensive study of the overall transportation picture." TIPRO has pointed out to ODM Director Arthur Flemming that: (1) Insufficient pipe line outlets link many areas having large reserve productive potentials, and a serious lag in connecting new wells and leases; (2) inadequate facilities of crude purchasers exist at points desired for accessibility to crude and products stored above ground, and (3) lack of line linking sections of the U. S. where oil producing deficiencies exist.

★ ★ ★

**Crude price increases ranging** from 6 to 21 cents per barrel have been posted by Creole Petroleum Corporation on six Venezuela low API gravity oils. The mid-November hike follows recent price rises in the Caribbean for similar crudes, and also reflects advances in No. 6 and similar heavy fuel oils in both the U. S. and Caribbean. Creole handles 42 per cent of the Venezuelan crude.

★ ★ ★

**All of Montana's gasoline and** motor vehicle tax receipts will be used exclusively for road construction and related purposes, according to a constitutional amendment passed in November. Montana became the twenty-seventh state to outlaw diversion of of highway funds to non-highway purposes.

★ ★ ★

**Oil imports issue has been** shelved indefinitely by ODM Director Arthur Flemming as a result of Middle East Crisis. The U. S., now exporting oil as fast as possible, has reversed its imports situation, which had in recent months become large enough for domestic producers to demand restrictions, for the sake of preserving the U. S. industry. As a result of recent events, the Advisory Committee has recommended that imports be voluntarily held in the same relation imports had to domestic production in 1954—about 16 per cent.

★ ★ ★

**J. Ed Warren, vice president** of the National City Bank of New York and formerly of Midland, Texas, has been named petroleum consultant to Secretary of the Interior Fred Seator. A successful independent producer, he became deputy petroleum administrator in the Department of Interior during the Korean War. Most recently, he has been a member of a task force advising the President's Cabinet Committee on energy resources policy.

★ ★ ★

**Fair trade prices on gasoline** are encountering legal troubles. Fair trading has been employed on the East Coast in an attempt to avoid price wars. Esso Standard Oil Company recently lost a federal court decision involving two Massachusetts service stations; Esso had an injunction suit against sales of its gasoline below an established minimum retail price. In the light of the ruling, Esso will not abandon fair trade pricing but, pending outcome of an appeal, will not enforce it — as far as "commercial sales" are concerned, say company spokesmen.

★ ★ ★

**Employee benefit plans of** Sunray Mid-Continent Oil Company and its affiliates have cost the company $2,311,000 in contributions in the past year. Under the plans the company makes contributions based on workers' salaries. Some 95 per cent of the 5400 eligible employees are participating in the group life and hospitalization, 82 per cent in the employees' saving plan, and 91 per cent in the retirement plan. During 1956, more than 60 employees retired under the plan.

★ ★ ★

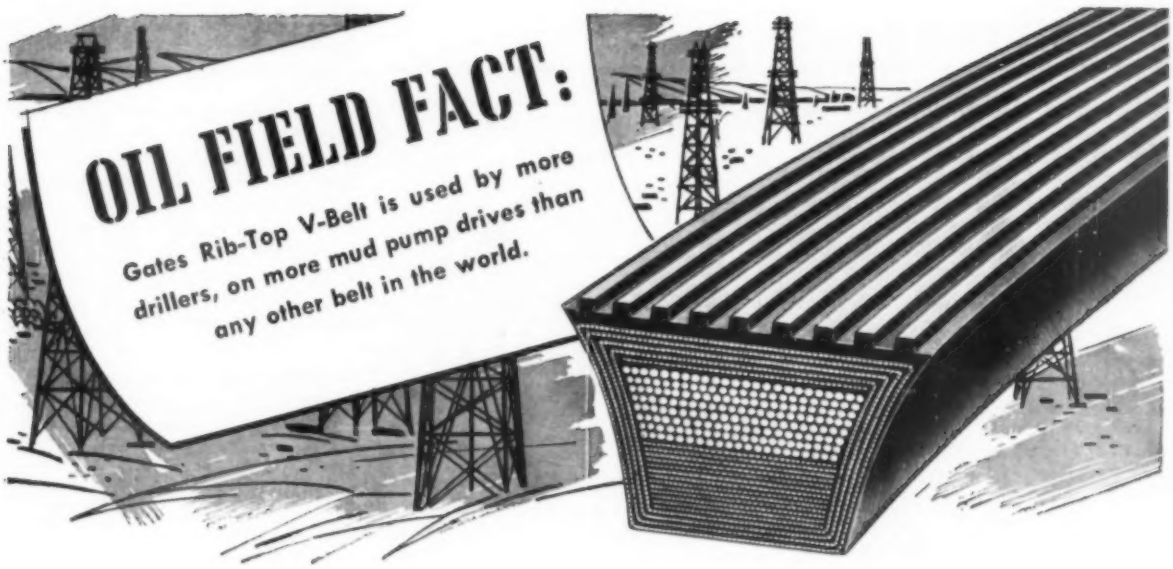
**American Society for Engineering** Education will give seven national awards in engineering education at its 1957 annual meeting at Cornell University June 17-21. Competition for the awards is now open, and nomination blanks are ready, according to Secretary Professor W. Leighton Collins, at the University of Illinois, Urbana, Illinois. The awards are the Lamme, the George Westinghouse, the Vincent Bendix, the Curtis W. McGraw Research Award, the James H. McGraw Award in Technical Institution Education, the President's Awards to young engineering teachers, and the Engineering Drawing Award.

**Annual Index for 1956 *The Petroleum Engineer***

The editorial index of articles published in all editions of *The Petroleum Engineer* during 1956 is now available.

Subscribers wishing to receive a free copy should write to this magazine, P. O. Box 1589, Dallas, Texas.

Please state company position and don't forget to include your address.




# World's leading V-Belt for drilling rigs

**If you want to reduce V-belt replacements and lower belt costs for mud pump drives, the belt to use is Gates Rib-Top Vulco Rope.**

Both Standard and Super Rib-Top V-Belts are available from your oil field supply house. You pay no more for Rib-Tops than for ordinary belts of comparable ratings. Specify Gates Rib-Tops next time you order. The Gates Rubber Co., Denver, Colorado—*World's Largest Maker of V-Belts.*

## Use Super Rib-Top for Toughest Drives

40% greater horsepower capacity. Easily handles drive overloads. Fewer belts and narrower sheaves solve space and weight problems.

Gates
The Mark of Specialized Research

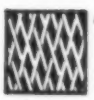
**4 Engineering Developments** enable Gates Rib-Top to deliver outstanding performance. These developments are the result of *specialized* research by the world's largest belt testing laboratories.

**1. Tougher, More Resilient Tensile Cords** enable Rib-Top V-Belts to absorb severe pulsations of the mud pump—easily handle peak loads.

**2. Concave Sidewalls** (U.S. PAT. NO. 1813698) as a Gates belt bends around a sheave the concave sides fill out . . . become straight . . . fit sheave grooves evenly (Fig. A). This uniform groove contact provides sure pulling power, less wear, longer V-belt life.

Straight-sided belts bulge at the sides when bent. Uneven contact (Fig. B) causes uneven wear, shortens belt life.

**3. Stabilizing Ribbed Top** (U.S. PAT. NO. 2548135) exclusive with Gates. Dampens vibration . . . protects top of belt against damage . . . keeps belt running smoothly over idler equipped mud pump drives, with no side slip.



**4. Flex-Weave Cover** (U.S. PAT. NO. 2519590) provides greater flexibility with far less stress on fabric. Wears longer . . . increases belt life . . . lowers belt costs.

TPA 85

# Gates Rib-Top Vulco Rope

DEVELOPED ESPECIALLY FOR MUD PUMP DRIVES

**Interior Secretary Fred A.** Seaton said that in the period from November 8 to December 5, individual American and foreign petroleum companies moved more than 14 million barrels of petroleum from the U. S. Gulf Coast to Europe. This was before the MEEC schedules began.

★ ★ ★

**The steel shortage may limit** new tanker construction. The National Petroleum Council, requested by the Interior Department to survey plans for tanker construction, reported that plans call for an increase from the present 43 million tons capacity to 72 million tons by the end of 1961. The Suez closure has spotlighted the need for greater tanker capacity. Even though it is reopened, the world would still be at the whim of a dictator unless tanker capacity is greatly enlarged.

★ ★ ★

**U. S. Interior Department announced** the appointment of J. Edwin Warren, vice president of First National City Bank of New York. He will act as an unpaid consultant on the Middle East Emergency Committee, which has the task of expediting oil shipments to Europe.

★ ★ ★

**Gulf Oil must answer charges** of violating the anti-trust law February 26 in Pittsburgh before the Federal Trade Commission. Gulf was charged with violating the anti-merger section by acquiring Warren Petroleum Corporation in March, 1956. W. K. Whiteford, Gulf president, said that Gulf and Warren had never been competitors. "The effect of the Gulf organization was not to remove a competitor but to add to our line of products."

★ ★ ★

**To the National Industrial Conference** Board, Herbert Willetts, vice president and director in charge of domestic marketing, Socony Mobil, gave these estimates for sales in 1957:

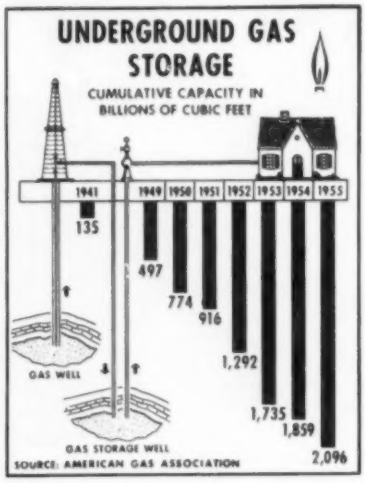
Gasoline sales to be 4 per cent up. Principal reason is that between 3 and 4 per cent more vehicles will be on the road than in 1956.

Aviation gasoline sales will not increase because of switch by military from piston engines to jet planes.

Diesel fuel sales should gain about 4 per cent.

Heating oil sales will probably be 5 to 6 per cent above 1956, assuming normal winter weather.

Jet fuel sales to be 12 per cent up; jet fuel still accounts for less than 3 per cent total oil products sales.




**Storage of natural gas in underground** reservoirs has increased more than tenfold in the past decade. Piped in during mild weather when demand is low, this "warehoused" gas will provide heat this winter for nearly 17,000,000 homes in the U. S.

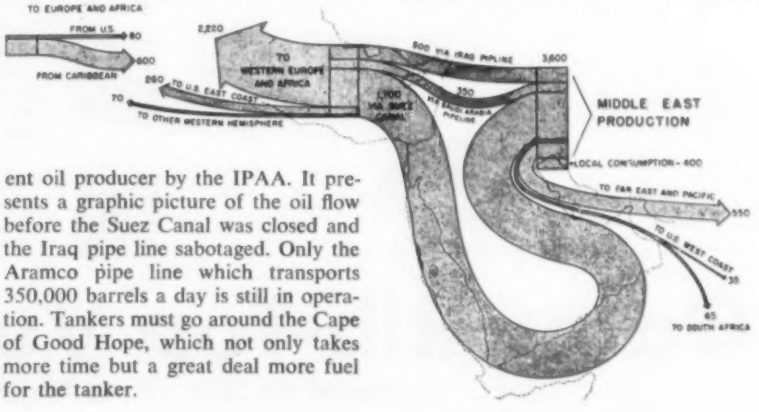
**Col-Tex Refining Company,** subsidiary of Cosden Petroleum, has been reorganized with R. L. Tollett as president. Cosden acquired Col-Tex in November from Standard Oil of Texas and Anderson-Prichard of Oklahoma City. General offices of Col-Tex will be moved to Big Spring, Texas from Oklahoma City.

★ ★ ★

**Sahara Petroleum Company,** owned by Continental, Cities Service, Ohio Oil and Richfield, has resumed operations in Egypt. When British and French troops took Suez, most employees and their families were evacuated to Rome, Italy.

★ ★ ★

**Flow of Middle East oil in 1956** is shown in this graph taken from the Facts and Forecasts for the independent oil producer by the IPAA. It presents a graphic picture of the oil flow before the Suez Canal was closed and the Iraq pipe line sabotaged. Only the Aramco pipe line which transports 350,000 barrels a day is still in operation. Tankers must go around the Cape of Good Hope, which not only takes more time but a great deal more fuel for the tanker.




**The Labor Department reports** a record 5,000,000 workers will get automatic wage increases in 1957. Some of these will be from cost-of-living escalator clauses in contracts. The department said that increases will be given to workers in almost every major industry group. Automatic increases have come with longer term contracts. (See editorial, Page A-4.)

★ ★ ★

**Socony Mobil has plans to sell** a large block of common stock and debentures of not more than $100 million to raise money for the company's long range plans to search for oil and to expand facilities. This will bring as much as $334 million for expansion. Phillips Petroleum has similar plans to raise $171 million. Proceeds will be used to pay off $86 million in loans and provide funds for expansion.

★ ★ ★

**Petroleum production in December** made a new high record. Estimates are that runs will average 7¾ million barrels a day. Some companies, such as Magnolia Petroleum, are making their first crude oil shipments to Europe from the Gulf Coast.

★ ★ ★

**The API public relations** branch has shortened its name from Oil Industry Information Committee (OIIC) to the Oil Information Committee (OIC). M. S. Hauser, Ohio Oil Company, is general chairman of the committee this year.

★ ★ ★

**Testifying before a subcommittee** dealing with U. S. Economic Report, Chalmer G. Kirkbride, Sun Oil Company, said that from 1947 to 1955 capital expenditures in refining by U. S. oil companies totaled $4.8 billion. This improvement, he said, made it possible to buy twice as much gasoline per hour's pay as 20 years ago.

# Good Wells Make Good News

Many operators are getting quick payout from Petrojel*. Since Petrojel makes use of the operator's own lease crude (gelled) as the fracturing fluid, treatment costs are low. Payouts have been correspondingly fast. Kerosene or diesel fuel may be used when lease crude is not available. Here are examples from different fields.

- ***Wise County, North Texas***—(New well) Completed in 60-foot, three-zone section of Strawn sand at 4,000 feet. Permeability estimated at 10-15 millidarcys. Swabbed only four barrels of oil per day. Treated with Petrojel using 15,000 gallons of fluid plus F.L.A.* (Fluid Loss Additive) and 15,000 pounds of sand—through tubing in three stages using straddle packers. After 60 days, well tested 80 barrels of oil per day. At 40 barrels of oil per day allowable, treatment cost of $1,455 paid out in 21 producing days.

- ***Colorado County, Texas Gulf Coast***—(Old gas well) Completed in Wilcox sand with perforations from 9,320 to 9,378 feet. Bottom-hole pressure-buildup test on this well indicated that a "skin effect" around the hole was holding potential to 6,900,000 cubic feet per day. The well was given a 250-gallon spearhead of Mud Acid. Then it was treated with Petrojel, using 6,000 gallons of fluid with 9,000 pounds of sand. Two months later, well was producing 13,000,000 cubic feet per day and open flow potential was 72,000,000.

- ***Southeastern Saskatchewan, Canada***—(New well, discovery) Completed in Mississippian Charles. Perforated from 5,983-5,990 feet the well had been acidized twice, yet production was only 40 barrels of oil per day. Dowell fractured through tubing with Petrojel, using 5,000 gallons of gelled diesel fuel and 8,000 pounds of sand. After $1,700 treatment, well tested 90 bopd.

- ***Barber County, Kansas***—(New well, gas) Completed in Mississippian chat of Driftwood pool through perforations from 4,835 to 4,867 feet. After acidizing, well tested 3,500,000 cubic feet per day. Petrojel, using kerosene for quick clean-up, was selected for further stimulation. Treatment used 25,000 gallons fluid with 30,000 pounds of sand and 1,250 pounds fluid loss control agent. Injection rate was 41.4 barrels per minute. After treatment, well potentialed 169,000,000 cubic feet per day.

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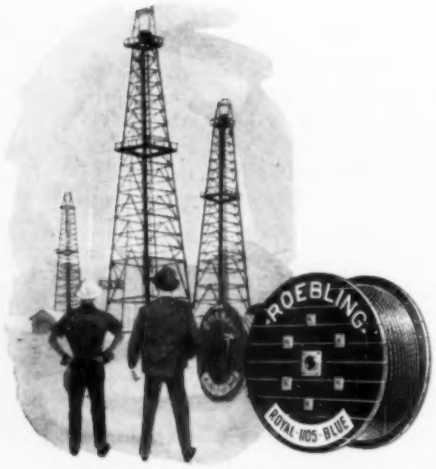


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# Meetings

Jan. 8-10—**Kentucky Petroleum Industries Committee,** convention, Noel Hotel and The Maxwell House, Nashville, Tennessee.

Jan. 14-16—**Pipe Line Contractors Association,** Boca Raton Hotel and Club, Boca Raton, Florida.

Jan. 14-18—**SAE,** annual meeting and engineering display, The Sheraton-Cadillac and Statler Hotels, Detroit, Michigan.

Jan. 16-18—**Society of Plastics Engineers, Inc.,** 13th annual technical conference, Sheraton-Jefferson Hotel, St. Louis, Missouri.

Jan. 17-18—**National Industrial Conference Board,** general session, Hotel Commodore, New York City.

Jan. 21-25—**American Institute of Electrical Engineers,** 1957 winter general, Hotel Statler, New York City.

Jan. 23-24—**Northwest Petroleum Association,** Nicollet Hotel, Minneapolis, Minnesota.

Jan. 28-31—**Plant Maintenance and Engineering Show,** Public Auditorium, Cleveland, Ohio.

Jan. 30-Feb. 1—**Institute on Law of Oil and Gas and Taxation,** 8th annual meeting, Southwestern Legal Center, Dallas, Texas.

Jan. 31-Feb. 1—**Instrument Short Course,** 6th annual, Los Angeles Harbor Junior College, Wilmington, California.

Feb. 5-7—**Reinforced Plastics Division of The Society of the Plastics Industry, Inc.,** 12th annual technical and management conference, Edgewater Beach Hotel, Chicago, Illinois.

Feb. 7-8—**Western Petroleum Refiners Association,** Gulf Coast regional technical-industrial relations meeting, Lamar Hotel, Houston, Texas.

Feb. 8-9—**ASTM,** symposium on composition of petroleum oil, committee D-2, Jung Hotel, New Orleans, Louisiana.

Feb. 13-15—**National Association of Corrosion Engineers,** 8th annual corrosion course for pipeliners, Mayo Hotel, Tulsa, Oklahoma.

Feb. 15-16—**National Society of Professional Engineers,** spring meeting, Hotel Francis Marion, Charleston, South Carolina.

Feb. 19-20—**American Society of Civil Engineers,** pipe line division, Jackson, Mississippi.

Feb. 21—**National Industrial Conference Board,** meeting of board, Waldorf-Astoria Hotel, New York City.

Feb. 22—**Natural Gasoline Association of America,** Permian Basin regional meeting, Scharbauer Hotel, Midland, Texas.

Feb. 24-28—**American Institute of Mining, Metallurgical, and Petroleum Engineers,** annual meeting, Hotels Roosevelt and Jung, New Orleans, Louisiana.

Feb. 26-27—**API Division of Marketing,** lubrication committee, Sheraton-Cadillac Hotel, Detroit, Michigan.

March 6-8—**API Division of Production,** southwestern district, Statler Hilton Hotel, Dallas, Texas.

March 10-13—**American Institute of Chemical Engineers,** Greenbrier Hotel, White Sulphur Springs, Virginia.

March 10-16—**Engineers Joint Council,** second nuclear engineering and science congress, Convention Hall, Philadelphia, Pennsylvania.

March 18-19—**Steel Founders' Society of America,** 55th annual meeting, Drake Hotel, Chicago, Illinois.

March 18-21—**Society of the Plastics Industry, Inc.,** annual national conference and Pacific Coast exposition, Hotel Biltmore, Los Angeles, California.

March 20-22—**API Division of Production,** southern district meeting, Washington Youree and Captain Shreve Hotels, Shreveport, Louisiana.

March 27-29—**American Power Conference,** Sherman Hotel, Chicago, Illinois.

April 1-4—**AAPG,** national convention, Kiel Auditorium, St. Louis, Missouri.

April 8-9—**Industrial Accident Prevention Association,** annual conference, Royal York Hotel, Toronto, Canada.

April 8-10—**AIME,** open hearth and blast furnace conference, William Penn Hotel, Pittsburgh, Pennsylvania.

April 8-12—**American Welding Society,** Sheraton and Bellevue Stratford Hotels, Philadelphia, Pennsylvania.

April 10-12—**API Division of Production,** Mid-Continent district meeting, Mayo Hotel, Tulsa, Oklahoma.

April 11-13—**AIME,** Pacific Northwest regional conference, Portland, Oregon.

April 16-18—**National Petroleum Association,** 54th semi-annual meeting, Cleveland, Ohio.

April 22-25—**Canadian Institute of Mining & Metallurgy,** annual general meeting, Chateau Laurier, Ottawa, Ontario, Canada.

April 24-26—**API Division of Production,** Rocky Mountain district meeting, Buena Vista Hotel, Biloxi, Mississippi.

April 24-26—**Natural Gasoline Association of America,** 36th annual convention, Rice Hotel, Houston, Texas.

April 25-26—**API Board of Directors,** Dallas, Texas.

April 28-30—**Independent Petroleum Association of America,** midyear meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

May 1-3—**API Division of Production,** Eastern district meeting, William Penn Hotel, Pittsburgh, Pennsylvania.

May 6-8—**API,** annual pipe line conference, Cleveland Hotel, Cleveland, Ohio.

May 6-8—**American Geophysical Union,** 38th annual meeting, Washington.

May 13-16—**API Division of Refining,** midyear meeting, Penn-Sheraton Hotel, Philadelphia, Pennsylvania.

May 19-22—**Texas Independent Producers and Royalty Owners Association,** 11th annual membership meeting, Galvez and Buccaneer Hotels, Galveston, Texas.

May 20-22—**API Division of Marketing,** midyear meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

May 20-24—**American Society for Testing Materials,** 5th conference on Mass Spectrometry, Commodore Hotel, New York City.

June 4-6—**Appalachian Underground Corrosion Short Course,** Morgantown, West Virginia.

June 9-14—**API Division of Production,** midyear committee conference, Muehlbach Hotel, Kansas City, Missouri.

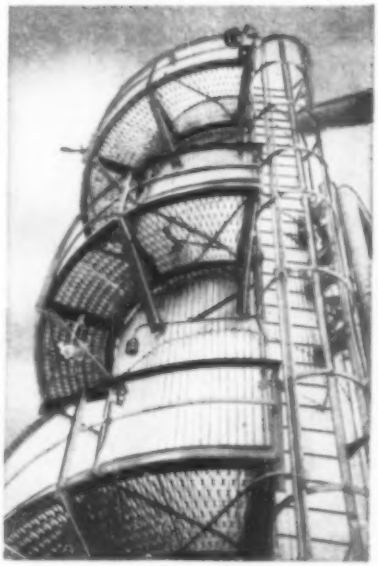
June 17-20—**Interstate Oil Compact Commission,** midyear meeting, Canyon Hotel, Yellowstone National Park, Wyoming.

June 24-28—**American Institute of Electrical Engineers,** 1957 summer general, Montreal, Quebec, Canada.

Oct. 9-10—**Third Annual Computer Applications Symposium,** sponsored by Armour Research Foundation of Illinois Institute of Technology, Morrison Hotel, Chicago, Illinois.

Nov. 30-Dec. 1—**Executive Committee of Interstate Oil Compact Commission,** Wichita, Kansas.


**RAIN OR SNOW CAN MAKE CATWALKS DANGEROUS**



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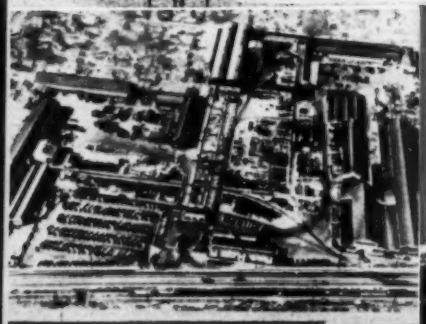

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# OUTLOOK FOR 1957:

# A RECORD BREAKER!

Ernestine Adams

THE new year arrived in the midst of an oil crisis. Supplies from the Middle East are closed in by the complete shutdown of the Suez Canal and sabotage of pumping stations on the Iraq Petroleum Company pipe line in Syria.

The consequences of taking large volumes of Middle East oil off the market casts a new look over the coming year. The event will have lasting influence on the oil industry. It reveals — as nothing else could — the strength and weaknesses of the petroleum industry.

Here are some of the things learned:

1. **The domestic oil industry is a great safeguard of the U. S. Our economy would be paralyzed without it. Europe's situation is a good object lesson to the U. S. A.**
2. **The Western Free World must have Middle East oil. There are few situations that would bring conflict more quickly than seizure of Arabian oil.**
3. **Domestic producers are liquidating reserves below cost. They know it but have been helpless with more supply than markets.**
4. **Ability of U. S. oil industry to meet emergencies with capacity margins is due to:**
   a. *Industry's vast expenditures for reserves and facilities since World War II.*
   b. *Percentage depletion that partly finances exploration and drilling.*
   c. *Conservation practices of the states under the Interstate Oil Compact program.*
5. **More transportation facilities are needed in this country for greater flexibility.**
6. **World distribution facilities need more surplus capacity.**

Our distinguished commentators on 1957 prospects for the industry had these things in mind when they predicted future trends. They have many interesting observations to make on things to come, the most comprehensive one being that all records will be broken for the U. S. petroleum industry.

## Estimate Capital Expenditure Up 9%

SOME authorities quoted here set capital investment in the U.S. at approximately $6 billion for 1956. Last January our forecast of $5 billion based on 21 company estimates was too low. It was revised in July (The Petroleum Engineer, July, 1956, Page A-12) to $5.7 billion investment in U. S. and $1.7 billion expenditure by U.S. companies abroad—a total of $7.4 billion.

The upward revision was made following a check of actual investments the first half of 1956. Most firms also raised their estimates for the last half.

Miss Adams is Management Editor.

Some figures or percentages were provided by 22 companies this year on their plans for 1957 capital expenditures.

Indicated investment in domestic and foreign operations by U.S. companies will increase by 9 per cent, topping $8 billion for the first time.

A rough estimate of how this vast expenditure will be divided, according to these early estimates are:

| | |
|---|---|
| **Drilling and Producing**[2] | **$5,300 million** |
| **Manufacturing** | **1,450 million** |
| **Transportation** | **650 million** |
| **Marketing** | **700 million** |
| **Miscellaneous** | **100 million** |
| **TOTAL** | **$8,100 million** |

Some companies did not give separate figures for foreign operations but there was evidence of intense interest in Western Hemisphere possibilities.

In announcing a $750,000,000 capital expansion program for the next 5 years, Cities Service stressed an immediate $30,000,000 expansion in refining and marketing in Canada.

Signal reports that its only increases in new investment over last year will be in foreign operations. Many medium and smaller companies are venturing into foreign operations. Perhaps as much as $1.8 billion of the total $8.1 billion will be spent abroad by U.S. firms and $6.3 billion in this country.

Estimates of expenditures in various branches of the indus-

[2]With the "wide divergencies in basic accounting methods," it is difficult to state definitely what drilling and producing cover. See Page A-9 to see how exploration is handled by accounting systems.

## Here are problems:

- **Steel shortages may limit some expansion.**
- **Higher costs of labor and material will cut profit margin.**
- **Depressed prices need stronger rise than appears likely.**
- **Federal control is headache for gas producers.**
- **Selective Europe demand increases gasoline stocks.**
- **Taxes remain high — can go higher.**

# Here's the picture=

- *Capital expenditures to top $8 billion*
- *U. S. products demand up about 5%*
- *Crude oil prices to keep edging up*
- *Nation's economic health in good shape*
- *Middle East crisis spotlights industry's role*
- *$4 billion highway building program in works*

try are set almost arbitrarily the first of the year.

In the production branch it is difficult to set a specific sum. A discovery well may mean several million for development or it may mean very little. That is one of the big reasons why estimates are often revised.

Drilling is expected to break all records. Robert L. Wood, president of IPAA, expects some 65,000 wells to be drilled. L. D. Campbell of Halliburton predicts 62,000 wells in 1957, up some 4000 from 1956. Jake L. Hamon, president of API, believes amount of tubular goods will set the limit.

The U.S. Commerce Department reports an $841,000,000 estimated investment for petroleum and coal products in the first quarter. This is 34 per cent higher than was actually spent the first three months of 1956.

Shortages of material may also set the limit on pipe line construction. Plans call for an all-time high.

## U. S. Demand Forecast at 3½ to 6% Up

INDUSTRY leaders last year estimated demand increase for 1956 at 3½ to 7 per cent. It will probably reach about 5½ to 6½ per cent more than 1955, which is higher than most forecasts.

Predictions for 1957 domestic demand run 3½ to 6 per cent above last year. Again we feel that consumption will be on the high side — up about 5 per cent. Intensified highway construction will account for added demand. So far $4 billion worth of highway contracts are in the works.

Demand outside the U. S. will be subject to limited supplies. In the rest of the Free World demand has been increasing at a much higher rate than in the United States. Last year it rose 11 per cent over 1955. Predictions this year for 8½ per cent may be adversely affected by world affairs. Europe's economic situation is suffering from lack of Middle East oil, but dollars are scarce and rationing of gasoline has already gone into effect.

If proposed U. S. aid is substantial, activity may be strong enough to make up for the early slow-down. Congress, however, may be unwilling to approve the rumored $5 billion for friendly nations.

## Imports Problem Temporarily Eclipsed

SEVERAL commentators on the following pages warn that we can depend too much on Europe's needs solving our own over-supply.

M. H. Robineau, president of The Independent Refiners Association of America, told federal officials that independent refineries were damaged by the plan to supply oil to Europe. Said he:

"It looks like aid to people in other countries is to be fulfilled at the expense of our own industrial strength and competitive system. Apparently, the probability of squeezing out the independent refining segment of the petrolum industry in the United States is secondary to keeping refineries in Europe running."

From the IPAA executive committee chairman, W. M. Vaughey, comes a statement that "Shipments of U.S. oil to Europe should come first from our excessive above-ground stocks which have accumulated largely as a result of excessive oil imports."

There will be little effort made to settle the import question until the Middle East supply gets fully in the market again.

## Price Trend Is Up — Still Low for Costs

STEEL prices are up, automobile prices are up, cost of living has hit a high mark, cost of labor has reached a new high, and the Oil, Chemical and Atomic Workers Union is asking for "basic wage increases of 27 cents an hour and substantial improvements in fringe benefits."

When is the price of oil going to move?

There have been some upward price adjustments since the Middle East muddle but these did little more than balance downward adjustments made in the summer and fall. Both crude oil and oil products are overdue a general price advance. It will be the first one since 1953.

As one of our commentators says, we are liquidating ourselves out of business.

Lately profit margins of petroleum companies have tended to narrow. This means tightening funds for capital expansion in a business that requires vast funds to replace and expand oil and gas reserves and operational facilities.

***You will find on the following six pages the thoughtful, informed opinions of top management on the New Year's potential. They give suggestions, too, on how best to face the problems. Taken together they will give you a clearer, broader understanding of what's ahead for the petroleum industry.***

# OIL AND GAS DEMAND, GENERAL EXPANSION MOVES HIGHER

## Higher Income Will Spur Development

Jake L. Hamon
Dallas, Texas
Board Chairman API

1957 should undoubtedly be a good year for the petroleum industry.

The closing of the Suez Canal should eventually cause a material reduction in domestic crude and residual stocks. When the canal is finally reopened, our old problems will be with us again.

The industry apparently will have the burden of excessive gasoline inventories to work with, as Europe apparently prefers to ration gasoline, due to their shortage of dollars. However, consumption in this country should be up about 3½ per cent at least, and with the states increasing their allowables, the domestic producing industry will be stimulated accordingly. Higher income either by increased crude prices, or by higher allowables, always increases development activity.

From all indications, the only limitation on drilling for next year will be the amount of tubular goods available.

## Modest Progress Visioned for 1957

P. C. Spencer
President
Sinclair Oil Corporation

EXCLUSIVE of special acquisitions directed to increasing Sinclair's crude oil production and reserves, the company's normal capital expenditures for 1956 will amount to $150,000,000. It is anticipated that such normal expenditures in 1957 may aggregate about $170,000,000, with almost 60 per cent devoted to crude producing activities.

Apart from the unpredictable events that may ensue as a result of the Middle East situation, we would look to 1957 as a year of probable modest progress for the petroleum industry. Our near-term view is one of cautious optimism, our long-term view is one of unqualified optimism.

## Will Double 1956 Capital Investment

George S. Patterson
President
Buckeye Pipe Line Co.

BUCKEYE Pipe Line Company in 1957 will continue to expand its crude oil and products pipe line facilities. Foremost on the 1957 list for capital expenditures will be a new products line extending 125 miles from Huntington, Indiana, to the East Chicago area. This will enable Ohio refiners to serve the Chicago market with direct pipe line connection. The company's Midwest products system will then serve the major cities of Chicago, Indianapolis, Toledo, Cleveland, and Columbus. Installation of additional pipe and pumping units will be made in 1957 on the company's main crude trunk line which serves Toledo, Detroit, Cleveland, and Buffalo to supply increased refining requirements.

Also, continuation of an extensive automation program, especially as regards crude and gathering line operations, will involve a considerable outlay. Altogether, a capital budget of $4,000,000 has been projected for 1957 or approximately double the amount spent in 1956.

It is anticipated that 1957 will be another good year for the domestic petroleum industry with anticipated U. S. demand up about 4 per cent. This increase should be reflected in pipe line deliveries.

## Government, Industry Spending Big Force

Rawleigh Warner
Chairman of Board
The Pure Oil Company

THERE are economic forces in motion today (December 3, 1956) which, by momentum alone, give assurance of continued general industrial expansion for at least six months. The most important of these are the high-spending commitments by national, state, and local governments in all areas, and by industry in the form of capital improvements.

In the oil industry, we estimate at this time that 1957 consumption of petroleum products in the United States will increase about 5 per cent from 1956. This would mean a domestic demand in excess of 9,250,000 bbl a day, an all-time high.

The industry's capital expenditures will continue to be heavy. We expect them to reach almost $6,000,000,000 in 1957.

## Plans Manufacture of Petrochemicals

Rexford S. Blazer
President
Ashland Oil & Refining

GENERAL prospects for the American oil industry in 1957 are very closely related to the world situation and particularly to developments in the Near East. Under present unsettled conditions abroad, it is difficult to make a forecast with regard to prospects for the coming year.

Our proposed cash expenditures for capital improvements during the 1957 fiscal year will exceed $20,000,000, of which it is estimated that half will be used for additional improvements to refineries and for the beginning of a program to manufacture petrochemicals.

## Outlook for Natural Gas Bright

Orville S. Carpenter
President
Texas Eastern Transmission

THE outlook for the natural gas industry for 1957 and in succeeding years is bright and optimistic. We have an ideal fuel to deliver to markets that are constantly increasing. To keep pace with this growth our facilities will have to be continuously expanded. In 1957 we will see many new expansion projects undertaken by the various segments of the industry. New developments in exploration, production, transmission, and distribution will be forthcoming that will better enable us to serve the demands for fuel that is already supplying about 26 per cent of our country's energy needs. We also hope to see solution of many of our major problems during 1957, particularly those of a legislative and regulatory nature.

# RATE OF CAPITAL INVESTMENT CONTINUES UPWARD TREND

## Plan Aggressive Expansion Program

W. C. Whaley
President
Sunray Mid-Continent

SUNRAY Mid-Continent Oil Company and its principal subsidiary, D-X Sunray Oil Company, made good progress on all fronts during 1956. In 1957 the companies expect to continue an aggressive program of exploration for new oil reserves, development of proven well locations, refinery improvement and expansion and new station marketing facilities.

During the first nine months of 1956 Sunray Mid-Continent discovered almost twice as many barrels of crude and liquid products as were produced during this period; some 23,000,000 bbl produced, some 42,000,000 bbl discovered. This means that for 1957 the company has several hundred drillable locations already spotted on its development maps and the exploration activity will be continued.

Capital expenditures in 1956 were about $62,000,000 and should certainly not be less than this in 1957, including $10,000,000 in high-octane gasoline manufacturing facilities at the two Oklahoma refineries.

## Capital Needed for Long-Run Demand

Henderson Supplee, Jr.
President
Atlantic Refining Co.

OUR present forecast is that domestic demand for petroleum products in 1957 will average about 9,265,000 bbl per day, or an increase of 4.1 per cent over 1956. We estimate that domestic demand in 1956 was 5.8 per cent higher than in 1955.

This forecast is based primarily on our expectation that the American economy as a whole will show approximately the same amount of growth in 1957 as in 1956. However, there are two main reasons why we do not expect petroleum demand to increase as much this year as last. First, the increase in gasoline demand will probably not be as great, because gains in gasoline sales in 1956 reflected the very high auto sales level of 1955, which of course was not repeated last year. Second, the forecast for heating oil demand assumes normal weather conditions, whereas the weather in early 1956 was colder than normal and heating oil sales rose accordingly.

The forecast discussed above pertains to domestic product demand only. It seems unlikely that the Suez situation will affect this demand to any significant degree, or that it will impede the U. S. oil industry's ability to supply the forecast domestic requirements. The closing of the Canal will, of course, have a pronounced but as yet largely indeterminable effect on domestic crude production and on exports and imports. For example, before the Middle East difficulties arose, our best estimate was that domestic crude production in 1957 would average about 7,290,000 bbl per day. It appears now, however, that when the full impact of the Suez closing is felt, production may have to be increased by at least 700,000 bbl per day over this figure.

The American oil industry has both the capacity and flexibility to deal with this emergency world situation and at the same time meet a domestic demand for products which has increased by over 60 per cent in the last 10 years. This ability is the result of the vast expenditures for plant and equipment which the industry has made since World War II. Total capital expenditures are now running at close to a $6.0 billion annual rate. In view of the long-run outlook — that domestic demand will increase by at least 25 per cent over the next five-year period — it seems quite unlikely that this rate of spending will decline very much in the foreseeable future.

In the case of Atlantic, the capital expenditure trend is upward. For example, our capital spending in 1956 (not including our purchase of Houston Oil Company) totaled about $75,000,000, against $60,000,000 in 1955. The figure in 1957 may range between $90 and $100,000,000. Well over half of our expenditures will continue to go into the effort to find and develop additional crude oil supplies, both domestic and foreign. Substantial amounts will be required to meet steady growth and constantly improving quality of products and services.

## Prices Too Low for Drilling Programs

W. M. Vaughey
Vaughey & Vaughey
Jackson, Mississippi

OUTLOOK for the domestic petroleum industry in 1957 indicates an opportunity for higher levels of activity than were expected prior to the Suez crisis. This will result from the temporary disruption of Middle East oil movements, together with expected increases in U. S. business and industrial activity. Domestic crude oil production will increase substantially, until normal movements of Middle East oil to Europe are restored.

To what extent this increased production will affect exploration, drilling and development remains to be seen. There are many serious contingencies, the most critical of which is the inadequacy of crude oil prices. The two primary essentials of a healthy industry are both market and price. Increased market when the price of crude oil is below replacement costs cannot assure either stability, or expansion.

Crude oil prices have been, and continue to be artificially depressed in relation to rising costs for wages, basic materials.

Our own company is typical of the small producing firms now caught in the cost-price squeeze. Over a period of time we have drilled, or participated in drilling, about 40 wells a year in principal areas; the Southeastern U. S. and the Rocky Mountains. We would hope to continue our program at least at this level in 1957, but cannot expect to unless crude prices are soon adjusted.

## Major Expansion Completed in 1956

M. H. Robineau
President
Frontier Refining Co.

OUR company's capital expenditures for 1957 will be less than in 1956, as we completed construction of a Platformer and Unifiner during 1956. In 1957 refinery capital expenditures will be nominal except for increasing the capacity of our asphalt unit; we expect no expansion of our pipe line facilities; we probably will spend half a million dollars or more on marketing; we will show an increase in capital expenditures in the production department.

We expect to show increased volume and increased earnings during 1957.

# FOREIGN OPERATIONS TO EXPAND RAPIDLY IF CONTRACTS ARE GOOD

# NO. 1 U. S. OIL PROBLEM IS THAT PRICE FAILS TO MEET COSTS

## Producing Segment Is Liquidating

John F. Lynch
President
La Gloria Oil and Gas Co.

CAPITAL expenditures of our company in 1957 will run $3,000,000 to $4,000,000.

The outlook for 1957 appears to be good. Demand domestically should be as good as it was in 1956. The rate of gain of natural gas and LPG will probably continue to increase percentage-wise ahead of other petroleum products. Because of the Middle East situation, it will be rather difficult to predict the specific demands of each product. Automobile sales are presently at a high level, which, along with some shipments to supplement European gasoline demands, should help the gasoline inventory problem.

The price of crude has lagged far behind the increased costs of finding new reserves. The producing segments of the industry is gradually liquidating itself out of business, for it is depleting its reserves that were found and developed at much lower costs 10 to 15 years ago. This trend must be stopped if we are to have a strong domestic oil industry, which without question is vital to our national defense.

## Sounds Warning on Products Inventory

L. F. McCollum
President
Continental Oil Company

IN 1956, the petroleum industry enjoyed another year of continued growth. New high records were set in the production of crude oil, natural gas, and natural gas liquids. These gains in physical output have been reflected in favorable earnings reports by most oil companies.

The year ahead promises to be one of further growth, although the rates of increase in domestic output and consumption may be somewhat smaller than in 1956. In approaching the new year, the industry faces three major economic problems which will require the attention of oil company managements.

First, there is the problem of working off the large gasoline inventories which have accumulated during the year. On November 30, gasoline inventories were about 18,000,000 bbl, or 11 per cent, above those of a year ago. This problem is particularly distressing because it is one that could easily have been avoided through more prudent management of refinery operating schedules. A reduction of only 109,000 bbl per day in refinery runs during the seven months, April through October, accompanied by a reduction from 49.7 to 49.4 per cent in gasoline yields, would have decreased gasoline production by 16,500,000 bbl and would have held gasoline inventories at reasonable levels. Meanwhile, the necessary distillate production could have been secured by merely increasing distillate yields from 22.4 to 22.7 per cent.

A second problem facing the industry in the new year will be that of working out arrangements to relieve the shortages of petroleum products in Europe, which have been caused by the trouble in the Middle East. Furnishing oil to Europe from this country is largely a problem of transportation; first by pipe line to the coastal areas and, subsequently, by tankers to points of consumption.

In our efforts to help Europe, we should guard against precipitous measures which might impair the health and vitality of the domestic industry. Crude oil stocks in this country were excessive at the time of the Suez crisis. Some withdrawals from these stocks have already been made for shipments to Europe. Additional withdrawals should be made, particularly from the high stocks in inland areas, before domestic crude oil production is increased to any material extent. Otherwise, we may experience aggravated crude surpluses inland while running short in coastal areas. It is also important to recognize that European demand will be primarily for crude oil, distillates, and residual fuel oil and will not occasion any major liquidation of the large gasoline inventories in this country.

Finally, the oil industry will carry into the new year the burden of rising oil finding and development costs which, during the past three and one-half years, have not been relieved by any advances in crude oil prices. The world-wide shortages of crude oil arising from the Middle Eastern situation and the upward trend in oil finding and development costs may, however, soon bring crude oil price advances.

## Price Increase Essential to Future Supply

Walter S. Hallanan
President
Plymouth Oil Company

THERE is every reason to believe that, measured in terms of production, capital expenditures and number of wells drilled, the petroleum industry will establish new records during 1957.

Unless there is a substantial increase in the price of crude, however, these new records will be achieved at the expense of severe impairment of the industry's ability to meet the normal expected increase in demand in the foreseeable future, not to mention any emergency demands.

The Suez crisis has brought recognition of the vital importance of the domestic oil industry of America and of the Western Hemisphere in the preservation of free institutions from the tyranny of Communism. The semi-paralysis of Western Europe's economy, resulting from the closing of the canal and the sabotage of Middle East pipe lines, has awakened the entire free world to the realization that there can be no permanent dependence upon petroleum reserves located under the shadow of Communist guns and in an area where our enemies are more numerous than our friends.

If the domestic industry receives an adequate and long overdue increase in crude prices, it can meet the demands of the uncertain world situation. If such increase is denied, it will be called upon to deplete its reserves and weaken its capital structure, and thereby imperil the national defense and the public welfare.

My opinion is that the grim realities and the simple economics involved will bring some measure of relief and encouragement to the domestic oil producer early in 1957. If that develops, the industry will be in position to take a long step forward in the expansion of productive facilities and in the maintenance of the adequate reserves.

## No Shortage of Places to Drill

C. H. Lyons, Sr., Lyons & Logan

EXPLORATION and drilling are certain to increase in 1957. The rate of increase will depend on availability of material and capital. There is definitely no shortage in places to drill.

Our company estimates that its expenditures in 1957 will be 50 per cent greater than in 1956.

# FOREIGN OPERATIONS TO EXPAND RAPIDLY IF CONTRACTS ARE GOOD

## Canadian 1957 Prospects Bright

M. S. Beringer
President
British American Oil Ltd.

1956 has been the most prosperous year in Canadian history, and economists are not finding it difficult to predict a bigger year for 1957.

In the 1956 pattern of crude oil production, Alberta still showed the largest increase in production, but Saskatchewan and Manitoba took a much larger share of the advance over 1955. The export market for Canadian crude accounted for more than half the growth in total production. These factors may be even more noticeable in 1957 because of the comparative limitations on domestic growth, the growing importance of Pacific Coast markets, particularly California refineries, and the outlets created for production in southeastern and southwestern Saskatchewan. An estimated increase in crude oil production of 75,000 bbl a day will bring a 1957 average of about 530,000 bbl a day.

Pipe line activity in Canada, a feature of 1956, will continue through 1957, with such significant developments as the scheduled movement of gas through the Westcoast Transmission line, further construction progress on the Trans-Canada gas pipe line, and the extension of Interprovincial crude line to refineries in the Toronto area.

Major developments have raised the throughput capacity of Canada's refineries to almost 700,000 bbl a day. In 1956 Canada's refineries increased approximately 17 per cent over the total throughput of 1955. This is in line with the demand growth, which is expected to be about 16 to 18 per cent over the previous year. The 1957 forecast is for an increase in product demand in the neighborhood of 15 per cent.

## Binding Contracts Vital to Private Capital

B. B. Jennings
Chairman of the Board
Socony Mobil Oil Company

THE coming year will see the petroleum industry deeply concerned with problems stemming from the situation in the Middle East and the attendant disruption of petroleum supply to the Eastern Hemisphere, particularly Europe. These developments will be felt by the domestic industry as much as by the international companies. I believe that the oil industry will respond to the challenge with the same sense of responsibility that has distinguished it in the past.

My hope is that, in meeting the many and complex problems which face us, we shall not forget a far larger problem which will remain even after immediate difficulties have been overcome. That has to do with the urgent need for the establishment of a moral standard based on recognition of the sanctity of contracts which will be applicable both to sovereign nations and to private parties. The universal acceptance of such a standard is essential if private capital is to continue to work for the benefit of mankind throughout the world.

In many areas, including the Middle East, private capital, contracting often with sovereign governments, has been the principal factor in the development of natural resources and trade. Private capital has already accomplished much in relatively underdeveloped areas and should be expected to accomplish a great deal more — provided, of course, that it is allowed to do so and that it can reasonably rely on contracts. Where agreements with governments are necessarily involved, respect for them is the foundation on which private enterprisers build. This, I think, must be accepted by leaders of all nations.

The ability of a sovereign nation to make a binding contract, after all, should be cherished and should be regarded among newer nations as a mark of maturity and responsibility — in other words, of true sovereignty. Violation of such contracts, on the other hand, must in the end harm both the defaulting government and the very concept of sovereignty. The acceptance of this principle in 1957 would earn the year an honored place in history.

## To Increase Capital Expenditures 20%

W. H. Helmerick, III
Executive Vice President
White Eagle Oil Company

SPEAKING principally as drilling contractors and producers of oil and gas we are not too optimistic for 1957. In our opinion, while there may be more total wells drilled, there will be a slowdown in deep exploratory drilling in this country and in the development of deeper production. This, of course, is brought about by the severe proration restrictions.

With no justifiable reason for the Government to impose legislative restrictions on imports it seems only prudent to again recognize that more domestic production will be supplanted by foreign imports. Weighed down already with the economics of oversupply the industry is also faced with the tightest money situation in the last 20 years. All in all, then, we look for a gross income no more than 10 per cent greater than 1956 with profit margins somewhat less than the previous year.

In the face of curtailed production, which not only reduces our income from our own wells but limits the opportunity we have as drilling contractors, we are forced to increase our capital expenditure budget to provide a larger base upon which our growth can be continued; therefore, our capital expenditure budget will be increased some 20 per cent over last year's $3,000,000.

[White Eagle's report dated December 7, 1956 states: It seems self-evident that a small company must join in the search for foreign reserves if it is to grow appreciably in the years ahead.]

## To Increase Latin American Operations

S. B. Mosher
President
Signal Oil & Gas Co.

WE anticipate another year of expansion and growth for our own company and for the petroleum industry in general.

Capital expenditures in 1957 for Signal Oil and Gas Company within the United States will probably equal 1956 outlays. However, our expenditures in new areas of Latin America may result in a total capital expenditures increase of 15 per cent.

In 1957, Western Hemisphere oil will undoubtedly assume increasing importance in meeting the free world's petroleum requirements. For instance, recent price increases for California heavy crude more truly reflect the value and recognize the strategic location of this supply. I would expect an increased interest to be focused upon offshore California and the Gulf Coast.

# MIDDLE EAST CRISIS HAS VARIED EFFECTS ON PETROLEUM INDUSTRY

## Warns Middle East Situation Temporary

Gordon Simpson
President
General American of Texas

HAD the Middle East flare-up not occurred, estimates of what 1957 will bring would probably have revolved about the idea of business as usual with reasonable expectations of normal, continued growth. Obviously the sabotage of the pipe line through Syria and Lebanon and the closing of the Suez Canal are the important factors in this troubled area. Adjustments to meet the increased demand for Western Hemisphere crude oil and products include a clear warning to the wary that this situation is temporary and will possibly return to normal much sooner than many expect.

Treating the impact of the Middle East situation as transitory, as it must be, producing companies such as General American, are certain to profit for a time by the temporary rise in demand for American crude oil. Independently of the Middle East crisis, they should experience material progress during 1957. An increase in the price of the crude oil would contribute to that result. Such an increase, which appeared to many to be unwarranted a few months ago, seems now quite in order. Shutting off of Arabian oil and the consequent taxing of our producing capacity have pointed up sharply the need for the discovery of additional domestic reserves and the attendant need of an added incentive to this search through a price adjustment.

General American's capital expenditures for 1957, in the absence of unpredictables, should follow substantially the pattern of 1956. Continued increase in the company's reserves through the investment of these capital funds is quite probable.

## Suez Emergency Changes World Picture

R. G. Follis
Chairman of the Board
Standard Oil of California

FAVORABLE economic conditions during the first 10 months of 1956 resulted in world petroleum demand increases that somewhat exceeded expectations at the beginning of the year. However, as 1956 drew to a close, the Middle East emergency radically altered the overall prospects for 1957.

Prior to the developments in the Suez, it had been anticipated that world petroleum demand gains would continue at a moderate but healthy pace, probably in the neighborhood of 13 per cent for Europe, compared to 15 per cent in the first 10 months of 1956; and 6 per cent for the United States, as compared to 6½ per cent in the whole of 1956. But while the U. S. outlook remained essentially unchanged even after the Suez crisis, the likelihood of gains for Western Europe was wiped out. To the contrary, with severe rationing imminent in those countries, it is now anticipated that European demand will be off by 5 to 10 per cent (compared to the normal months of 1956) for a period of at least six months.

Europe's oil shortage should stimulate sizeable exports from the United States in 1957, reversing what had previously been a declining trend. The result will be increased crude oil production in the U. S., Canada and Venezuela, with exports from the latter countries likewise due to be increased.

Notwithstanding the complications imposed by the Middle East controversy, continuation of a basic long-term growth of world petroleum consumption is expected, with consequent large-scale capital expenditures by the industry, particularly for exploration and development of crude oil resources.

Expenditures by Standard Oil Company of California in 1956 amounted to about $350,000,000, some 70 per cent of which was allocated to exploration and production operations. Although the 1957 outlay is not as yet finally determined, next year's allocation is expected to surpass the 1956 figure, again with about 70 per cent of the total devoted to exploration and production.

## Transportation Limits Help to Europe

Robert E. Wilson
Chairman of the Board
Standard Oil (Indiana)

NOW with Suez blocked (which has recently handled about 1,500,000 bbl per day, mostly crude oil) and several pump stations destroyed on the crude pipe line from Iraq to the Mediterranean . . . Europe needs close to a million barrels per day, mainly crude oil, from the U. S., but they would find it difficult to either transport or pay for that much. While this country could easily *produce* that much more crude, we could not get that much more to the Gulf Coast with existing facilities.

My best estimate is that for the next six months we could ship an additional 750,000 bbl per day of crude and fuel oils from the Gulf Coast, partly out of stocks on hand, but about 300,000 of this would probably have to go to our East Coast to make up for the loss of Middle East imports, which would either be cut off or diverted to Europe, so we would find it hard to export more than 450,000 bbl per day to Europe.

However, Europe would also get some Mid-East crude diverted from our East Coast, and some additional crude from Venezuela. We would, of course, be glad to ship some gasoline, the one product of which we have a substantial surplus, but they will take very little of that because they can ration gasoline, and will want to run their own refineries as much as possible.

If Europe's dollar problems are worked out, domestic production may well be increased as much as 750,000 bbl per day, or nearly 10 per cent, as long as the crisis lasts.

## Middle East Oil Will Be Higher

Robert F. Windfohr
Nash, Windfohr & Brown
Fort Worth, Texas

REGARDLESS of its adverse effects on other peoples of the world the closing of the Suez Canal not only assures the domestic oil industry that 1957 will be its best year but, what is more important in the long term, that there will never again be a flood of cheap Middle East oil.

The Arab sheiks and kings of the Middle East perhaps have long suspected that they had the determining supply of a commodity indispensable to the present-day world, but their faith in this conviction must have been shaken by the failure of the Iran shutdown to have any important effect on world petroleum supplies. Now, however, with the Suez closed they know for certain that the world cannot live without their oil. Historically Arabs have never needed anyone to do their trading for them in a situation of this sort.

# DOMESTIC CONSUMPTION IS ESTIMATED 4% TO 6% HIGHER IN 1957

## Moderately Higher Levels Predicted

J. C. Donnell, II
President
The Ohio Oil Company

DESPITE the appearances of several soft spots in our economy, namely in residential construction and business inventories as well as the tight money situation, we expect the increases in consumer outlays, business investment, and public spending during 1957 to carry the general economy into moderately higher levels. It is also likely that the trend in wage increases, increases that are in excess of productivity gains, will continue to exert an upward pressure on prices. Accordingly, the projected increase in gross national product will be partly real and partly the result of inflation.

We forecast domestic demand for petroleum in 1957 at approximately 9,300,000 bbl per day, up about 4½ per cent over the indicated demand for 1956. A continuation of difficulties in the Middle East will result in additional exports of petroleum, a reduction in imports, and an increase in domestic production substantially greater than the increase in domestic demand.

## Total Export Trend Will Be Reversed

Reese H. Taylor
Chairman of the Board
Union Oil of California

WITH respect to prospects for 1957, we expect, in line with the generally optimistic outlook for a further growth in business activity during the coming year, that total domestic oil demand in 1957 will show an increase of between 5 and 6 per cent over 1956. Jet fuel, we believe, will be the leader in terms of percentage growth, increasing approximately 20 per cent. Gasoline demand is anticipated at a level some 5 per cent above that of 1956. Domestic demand for heating oils will probably be up also.

In view of United States plans to ship oil to Europe, total exports are expected to increase in 1957, thus reversing the downward trend of recent years. This fact, coupled with the projected growth in domestic oil demand, indicates another good year for the U. S. petroleum industry.

## Predicts U. S. Demand Up 4%

M. J. Rathbone
President
Standard Oil (New Jersey)

DEMAND for products in the United States is running about 5½ per cent ahead of last year, which is more than we had looked for at the beginning of 1956. In the rest of the Free World, petroleum consumption is up by an impressive 11 per cent over 1955, again somewhat above what we had expected.

Predictions are a little difficult to make. On the whole, though, our forecasts are optimistic. For instance, we think that the demand for oil in the United States will climb about another 4 per cent. Our estimates for the rest of the Free World were up about 8½ per cent before the recent troubles in the Middle East.

There is no doubt that the Middle East situation is serious, particularly so far as oil supply is concerned. The closing of the Suez Canal, and the damage to the pump stations on the IPC pipe lines, have temporarily shut off Western Europe's principal source of oil. There are just enough tankers to make up the deficit by carrying oil to Europe around the Cape of Good Hope. Until normal transportation routes are reopened, the industry will have to help fill the gap by shipping supplies to Europe from the Western Hemisphere.

Millions of barrels of additional oil (mostly crude) have already been shipped from the U. S. Gulf and Caribbean in an effort to cover the European needs. Most of the volume was supplied from inventories. Enough additional oil to supply Western Europe with all but about 15 per cent of its normal requirements can be made available in the Western Hemisphere during this interim period. Some of this oil will come from Caribbean sources, but most of it will have to come from the United States which has considerable excess producing capacity. We estimate that the domestic industry right now can supply about 750,000 bbl a day to do this job, without stinting domestic customers and certainly without rationing.

## Demand Increase Put at 5%

K. S. Adams
Chairman of the Board
Phillips Petroleum Co.

PHILLIPS Petroleum Company's capital expenditures in 1956 are estimated in excess of $230,000,000. This includes expenditures for major manufacturing facilities, some of which will not be completed until the first half of 1957. We anticipate that total capital expenditures this coming year will be materially less than in 1956.

It appears that normal petroleum sales within the United States will again increase in 1957 by about 5 per cent. The ever-increasing demand points to the need for our nation to maintain adequate domestic reserves and producing capacity. This cannot be accomplished unless the prices for crude oil produced in this country keep pace with increased costs. Yet, there has been no general increase in crude oil prices since June, 1953.

Recent developments in the Middle East have focused more attention than ever before on the importance of a dependable American oil enterprise.

## Expanded Capital Budget Available

R. L. Tollett
President
Cosden Petroleum Corp.

DURING 1956 the economics of our industry have been generally favorable. Excessive inventories of automotive grade gasoline have prevailed most of this year. Refinery realizations have accordingly been lower than some of us expected at the beginning of the year, but on the whole the spread between cost of crude oil and realization from the principal products has favored maintenance of reasonable earnings.

This year we have been able to increase our dividend distributions, but our retention of earnings has been greater than in past years. We have funds available for an expanded capital budget in 1957.

In common with others the Suez crisis will affect our operations, but we view 1957 with confidence and in the belief that earnings will be greater next year than in 1956.

## CPA finds widely divergent practice in the oil industry

# Petroleum Accounting

WIDE divergencies among the nation's petroleum producers in accounting for leasehold, exploration and development costs, are discussed in an article by Horace R. Brock, CPA, which appears in the December issue of *The Journal of Accountancy*.

"Public accountants examining the accounts of oil operators must rely largely on their own experience to determine whether accounting treatments accorded specific transactions and items should be regarded as 'generally accepted.' There appears to be available to the public no factual presentation of accounting policies or principles actually being followed by various members of the petroleum industry. Neither does there appear to be a criterion by which to judge the propriety of practices followed by producers," states the author.

After pointing out that there does not appear to be agreement as to accounting practices to be followed by oil producers, the article, based on information gathered from 61 companies that produced 63 per cent of the total United States output of crude oil in 1953 (Table 1) discloses these findings:

1. Sixty-five per cent of the firms capitalize only those exploration costs directly attributed to the discovery and development of specific oil and gas reserves, while 35 per cent expense all such costs. None of the companies capitalize all exploration costs.

2. Fifty-nine of the companies have employees engaged in activities leading to the acquisition of leases, but only 14 attempt to capitalize to leaseholds any portion of leasing costs incurred by their own staffs.

3. Thirty-seven of the 50 companies which make fixed rental payments charge the costs to current expense, while the other 13 capitalize the payments to leaseholds.

4. Forty-six of the producers capitalize all intangible drilling and development costs incurred in connection with the drilling of producing wells, but only five of these companies make any provision at the end of the fiscal period for costs of incomplete wells that are expected to be dry holes. The other 41 charge costs of dry holes to expense only when the well is completed and nonproductive.

5. Only 13 companies amortize leasehold costs, but 10 of these companies are among the largest 26 operators.

Tables shown below give an idea of the diversification Dr. Brock found in his survey. In the article he makes some recommendations for minimizing the differences in existing treatment.

States the author in conclusion:

"It is felt that the demonstrated lack of agreement and absence of uniformity may be due in part to a lack of knowledge by both public accountants and petroleum accountants of the various policies actually being followed by many oil operators in accounting for these costs. It should be stressed that the findings of this summary do not indicate tax practices and policies, but only financial accounting treatments. It is hoped, in conclusion, that these discussions will give interested persons a wider perspective of the various treatments being accorded these items and, in that way, stimulate inquiry into the underlying causes of the variances, and add some little toward the establishment of more nearly uniform 'generally accepted' accounting standards throughout the oil industry."

The author of the article is associate professor of accounting at North Texas State College, Denton, Texas. He received his PhD from the University of Texas. He is a member of the AIA and Texas Society of CPA's.

**TABLE 1. Classification of companies included in this study based on net crude oil production in the United States in 1953.**

| Class | Net U. S. crude oil production in 1953 (bbl.) | Total no. of firms in class |
|---|---|---|
| I | &50,000,000 and over | 6 |
| II | &30,000,000 — 49,999,999 | 9 |
| III | 5,000,000 — 29,999,999 | 11 |
| IV | 1,000,000 — 4,999,999 | 14 |
| V | Less than 1,000,000 | 21 |
| Total | | 61 |

**TABLE 2. Accounting treatments given by 61 oil companies to costs of exploration where work is performed by outside exploration companies.**

| Number of companies that: | Class I | II | III | IV | V | Total |
|---|---|---|---|---|---|---|
| Conduct no exploration | — | — | — | — | 1 | 1 |
| Expense all costs | 4 | 6 | 8 | 2 | 2 | 22 |
| Capitalize costs of work leading to reserves | 2 | 3 | 3 | 12 | 18 | 38 |
| Totals | 6 | 9 | 11 | 14 | 21 | 61 |

**TABLE 3. Accounting treatments given by 61 oil companies to costs of exploration work performed by companies' own staffs.**

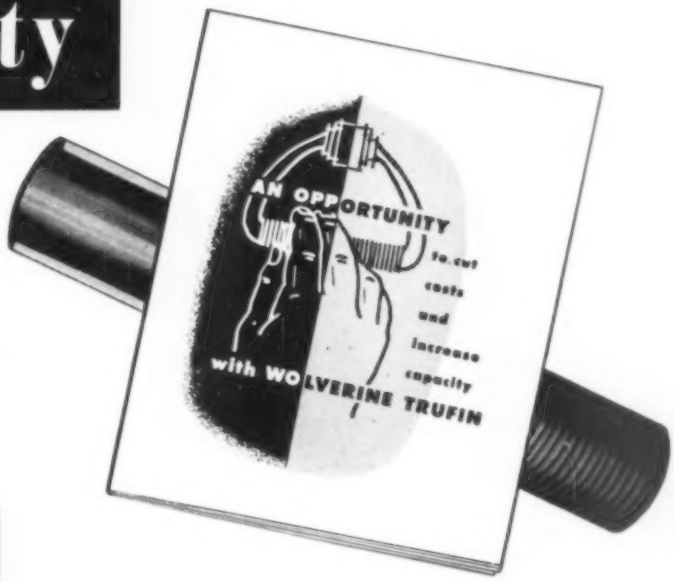
| Number of companies that: | Class I | II | III | IV | V | Total |
|---|---|---|---|---|---|---|
| Have no exploration staffs | — | — | 1 | 1 | 1 | 3 |
| Expense all costs | 4 | 7 | 10 | 8 | 15 | 44 |
| Capitalize costs of work leading to reserves | 2 | 2 | — | 5 | 5 | 14 |
| Totals | 6 | 9 | 11 | 14 | 21 | 61 |

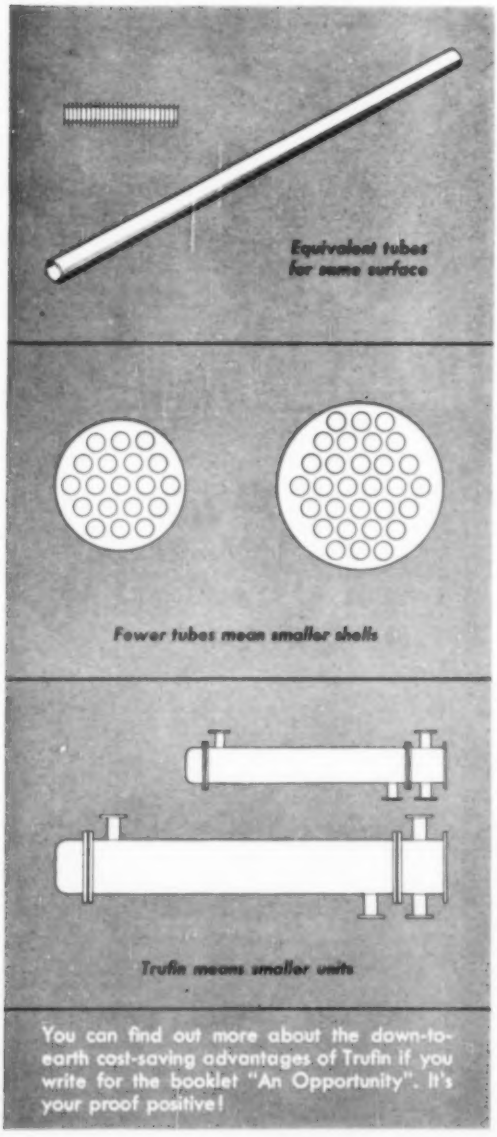
**TABLE 4. Accounting treatments given by 61 oil companies to payments to outside exploration companies for work on acreage covered by acreage selection options if leases are taken as a result of the survey.**

| Number of companies that: | Class I | II | III | IV | V | Total |
|---|---|---|---|---|---|---|
| Have no such work | — | — | — | — | 3 | 3 |
| Expense full cost | 4 | 6 | 8 | 2 | 2 | 22 |
| Capitalize full cost | 2 | 3 | 2 | 4 | 12 | 23 |
| Capitalize part of cost | — | — | 1 | 8 | 4 | 13 |
| Totals | 6 | 9 | 11 | 14 | 21 | 61 |

# Opportunity Knocks Twice

. . . IN THE LIGHT HYDROCARBON CONDENSING FIELD

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# ROTARY BITS—SPEED OF OUTER EDGE AND AREA SCOURED BY BIT AT VARIOUS TABLE SPEEDS

| Table speed r.p.m. | Speed of outer bit edge, ft. per min. — Diameter of bit in. | | | | | | | | | | | | | Area scoured by bit sq. ft. per min — Diameter of bit. in | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4¼ | 4⅝ | 5⅛ | 5⅞ | 6 | 6⅛ | 6⅛ | 6¾ | 7 | 7⅛ | 7⅝ | 8⅜ | 8⅝ | 4¼ | 4⅝ | 5⅛ | 5⅞ | 6 | 6⅛ | 6⅛ | 6¾ | 7 | 7⅛ | 7⅝ | 8⅜ | 8⅝ |
| 100 | 111 | 124 | 147 | 154 | 157 | 160 | 170 | 177 | 183 | 196 | 200 | 219 | 226 | 9.85 | 12.3 | 17.3 | 18.8 | 19.6 | 20.5 | 23.0 | 24.9 | 26.7 | 30.7 | 31.7 | 38.3 | 40.6 |
| 125 | 139 | 156 | 184 | 192 | 196 | 201 | 213 | 221 | 229 | 246 | 250 | 274 | 282 | 12.3 | 15.4 | 21.6 | 23.5 | 24.6 | 25.6 | 28.8 | 31.1 | 33.4 | 38.4 | 39.6 | 47.8 | 50.7 |
| 150 | 167 | 187 | 221 | 231 | 236 | 241 | 255 | 265 | 275 | 295 | 299 | 329 | 339 | 14.8 | 18.5 | 25.9 | 28.2 | 29.5 | 30.7 | 34.6 | 37.3 | 40.1 | 46.0 | 47.6 | 57.4 | 60.9 |
| 175 | 195 | 218 | 258 | 269 | 275 | 281 | 298 | 309 | 321 | 344 | 349 | 384 | 395 | 17.2 | 21.5 | 30.2 | 33.0 | 34.4 | 35.8 | 40.3 | 43.5 | 46.8 | 53.7 | 55.5 | 67.0 | 71.0 |
| 200 | 223 | 249 | 295 | 308 | 314 | 321 | 340 | 353 | 367 | 393 | 399 | 439 | 452 | 19.7 | 24.6 | 34.5 | 37.7 | 39.3 | 40.9 | 46.1 | 49.7 | 53.5 | 61.4 | 63.4 | 76.5 | 81.1 |
| 225 | 250 | 280 | 331 | 346 | 353 | 361 | 383 | 398 | 412 | 442 | 449 | 493 | 508 | 22.2 | 27.7 | 38.8 | 42.4 | 44.2 | 46.0 | 51.8 | 55.9 | 60.1 | 69.0 | 71.3 | 86.1 | 91.3 |
| 250 | 278 | 311 | 368 | 385 | 393 | 401 | 426 | 442 | 458 | 491 | 499 | 548 | 565 | 24.6 | 30.8 | 43.2 | 47.1 | 49.1 | 51.2 | 57.6 | 62.1 | 66.8 | 76.7 | 79.3 | 95.7 | 101. |
| 275 | 306 | 342 | 405 | 423 | 432 | 441 | 468 | 486 | 504 | 540 | 549 | 603 | 621 | 27.1 | 33.9 | 47.5 | 51.8 | 54.0 | 56.3 | 63.4 | 68.3 | 73.5 | 84.4 | 87.2 | 105. | 112. |
| 300 | 334 | 373 | 442 | 461 | 471 | 481 | 511 | 530 | 550 | 589 | 599 | 658 | 677 | 29.6 | 36.9 | 51.8 | 56.5 | 58.9 | 61.4 | 69.1 | 74.6 | 80.2 | 92.0 | 95.1 | 115. | 122. |
| 325 | 362 | 404 | 479 | 500 | 511 | 521 | 553 | 574 | 596 | 638 | 649 | 713 | 734 | 32.0 | 40.0 | 56.1 | 61.2 | 63.8 | 66.5 | 74.9 | 80.8 | 86.9 | 99.7 | 103. | 124. | 132. |
| 350 | 390 | 435 | 516 | 538 | 550 | 561 | 596 | 618 | 642 | 687 | 699 | 768 | 790 | 34.5 | 43.1 | 60.4 | 65.9 | 68.7 | 71.6 | 80.6 | 87.0 | 93.6 | 107. | 111. | 134. | 142. |
| 375 | 417 | 467 | 552 | 577 | 589 | 602 | 638 | 663 | 687 | 737 | 749 | 822 | 847 | 36.9 | 46.2 | 64.7 | 70.6 | 73.7 | 76.7 | 86.4 | 93.2 | 100. | 115. | 119. | 143. | 152. |
| 400 | 445 | 498 | 589 | 615 | 628 | 642 | 681 | 707 | 733 | 786 | 798 | 877 | 903 | 39.4 | 49.2 | 69.0 | 75.3 | 78.6 | 81.8 | 92.2 | 99.4 | 107. | 123. | 127. | 153. | 162. |
| 425 | 473 | 529 | 626 | 654 | 668 | 682 | 723 | 751 | 779 | 835 | 848 | 932 | 960 | 41.9 | 52.3 | 73.4 | 80.0 | 83.5 | 87.0 | 97.9 | 106. | 114. | 130. | 135. | 163. | 172. |
| 450 | 501 | 560 | 663 | 692 | 707 | 722 | 766 | 795 | 825 | 884 | 898 | 987 | 1016 | 44.3 | 55.4 | 77.7 | 84.7 | 88.4 | 92.1 | 104. | 112. | 120. | 138. | 143. | 172. | 183. |
| 475 | 529 | 591 | 700 | 731 | 746 | 762 | 808 | 839 | 871 | 933 | 948 | 1042 | 1073 | 46.8 | 58.5 | 82.0 | 89.4 | 93.3 | 97.2 | 109. | 118. | 127. | 146. | 151. | 182. | 193. |
| 500 | 557 | 622 | 737 | 769 | 786 | 802 | 851 | 884 | 917 | 982 | 998 | 1097 | 1129 | 49.3 | 61.6 | 86.3 | 94.2 | 98.2 | 102. | 115. | 124. | 134. | 153. | 159. | 191. | 203. |
| 525 | 584 | 653 | 773 | 807 | 825 | 842 | 894 | 928 | 962 | 1031 | 1048 | 1151 | 1185 | 51.7 | 64.6 | 90.6 | 98.9 | 103. | 107. | 121. | 130. | 140. | 161. | 166. | 201. | 213. |
| 550 | 612 | 684 | 810 | 846 | 864 | 882 | 936 | 972 | 1008 | 1080 | 1098 | 1206 | 1242 | 54.2 | 67.7 | 94.9 | 104. | 108. | 113. | 127. | 137. | 147. | 169. | 174. | 210. | 223. |
| 575 | 640 | 715 | 847 | 884 | 903 | 922 | 979 | 1016 | 1054 | 1129 | 1148 | 1261 | 1298 | 56.6 | 70.8 | 99.2 | 108. | 113. | 118. | 132. | 143. | 154. | 176. | 182. | 220. | 233. |
| 600 | 668 | 746 | 884 | 923 | 943 | 962 | 1021 | 1060 | 1100 | 1178 | 1198 | 1316 | 1355 | 59.1 | 73.9 | 104. | 113. | 118. | 123. | 138. | 149. | 160. | 184. | 190. | 230. | 243. |
| 625 | 696 | 778 | 921 | 961 | 982 | 1003 | 1064 | 1104 | 1146 | 1228 | 1248 | 1371 | 1411 | 61.6 | 76.9 | 108. | 118. | 123. | 128. | 144. | 155. | 167. | 192. | 198. | 239. | 254. |
| 650 | 723 | 809 | 957 | 1000 | 1021 | 1043 | 1106 | 1149 | 1191 | 1277 | 1297 | 1425 | 1468 | 64.0 | 80.0 | 112. | 122. | 128. | 133. | 150. | 162. | 174. | 199. | 206. | 249. | 264. |
| 675 | 751 | 840 | 994 | 1038 | 1060 | 1083 | 1149 | 1193 | 1237 | 1326 | 1347 | 1480 | 1524 | 66.5 | 83.1 | 117. | 127. | 133. | 138. | 156. | 168. | 180. | 207. | 214. | 258. | 274. |
| 700 | 779 | 871 | 1031 | 1077 | 1100 | 1123 | 1191 | 1237 | 1283 | 1375 | 1397 | 1535 | 1581 | 69.0 | 86.2 | 121. | 132. | 137. | 143. | 161. | 174. | 187. | 215. | 222. | 268. | 284. |
| 725 | 807 | 902 | 1068 | 1115 | 1139 | 1163 | 1234 | 1281 | 1329 | 1424 | 1447 | 1590 | 1637 | 71.4 | 89.2 | 125. | 137. | 142. | 148. | 167. | 180. | 194. | 222. | 230. | 277. | 294. |
| 750 | 835 | 933 | 1105 | 1154 | 1178 | 1203 | 1277 | 1325 | 1375 | 1473 | 1497 | 1645 | 1694 | 73.9 | 92.3 | 129. | 141. | 147. | 153. | 173. | 186. | 200. | 230. | 238. | 287. | 304. |
| 775 | 863 | 964 | 1142 | 1192 | 1218 | 1243 | 1319 | 1369 | 1421 | 1522 | 1547 | 1700 | 1750 | 76.3 | 95.4 | 134. | 146. | 152. | 159. | 179. | 193. | 207. | 238. | 246. | 297. | 314. |
| 800 | 890 | 995 | 1178 | 1230 | 1257 | 1283 | 1362 | 1414 | 1466 | 1571 | 1597 | 1754 | 1806 | 78.8 | 98.5 | 138. | 151. | 157. | 164. | 184. | 199. | 214. | 245. | 254. | 306. | 325. |
| 825 | 918 | 1026 | 1215 | 1269 | 1296 | 1323 | 1404 | 1458 | 1512 | 1620 | 1647 | 1809 | 1863 | 81.3 | 102. | 142. | 155. | 162. | 169. | 190. | 205. | 221. | 253. | 262. | 316. | 335. |
| 850 | 946 | 1057 | 1252 | 1307 | 1335 | 1363 | 1447 | 1502 | 1558 | 1669 | 1697 | 1864 | 1919 | 83.7 | 105. | 147. | 160. | 167. | 174. | 196. | 211. | 227. | 261. | 270. | 325. | 345. |
| 875 | 974 | 1089 | 1289 | 1346 | 1375 | 1404 | 1489 | 1546 | 1604 | 1719 | 1747 | 1919 | 1976 | 86.2 | 108. | 151. | 165. | 172. | 179. | 202. | 217. | 234. | 268. | 277. | 335. | 355. |
| 900 | 1000 | 1120 | 1326 | 1384 | 1414 | 1444 | 1532 | 1590 | 1650 | 1768 | 1796 | 1974 | 2032 | 88.7 | 111. | 155. | 169. | 177. | 184. | 207. | 224. | 241. | 276. | 285. | 344. | 365. |
| 925 | 1030 | 1151 | 1363 | 1423 | 1453 | 1484 | 1574 | 1634 | 1696 | 1817 | 1846 | 2029 | 2089 | 91.1 | 114. | 160. | 174. | 182. | 189. | 213. | 230. | 247. | 284. | 293. | 354. | 375. |
| 950 | 1057 | 1182 | 1399 | 1461 | 1492 | 1524 | 1617 | 1679 | 1741 | 1866 | 1896 | 2083 | 2145 | 93.6 | 117. | 164. | 179. | 187. | 194. | 219. | 236. | 254. | 291. | 301. | 363. | 385. |
| 975 | 1085 | 1213 | 1436 | 1500 | 1532 | 1564 | 1659 | 1723 | 1787 | 1915 | 1946 | 2138 | 2202 | 96.0 | 120. | 168. | 184. | 191. | 199. | 225. | 242. | 261. | 299. | 309. | 373. | 396. |

**Remarks:** Often in drilling-time studies of different size bits, it is desirable to correlate the data in terms of the peripheral speed of the bit and of the effective area of hole traversed by the entire face of the bit. The above table is designed as an aid in such studies.

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There is no substitute for ROLLED ALLOY STEEL HAMMER FORGED POINTS

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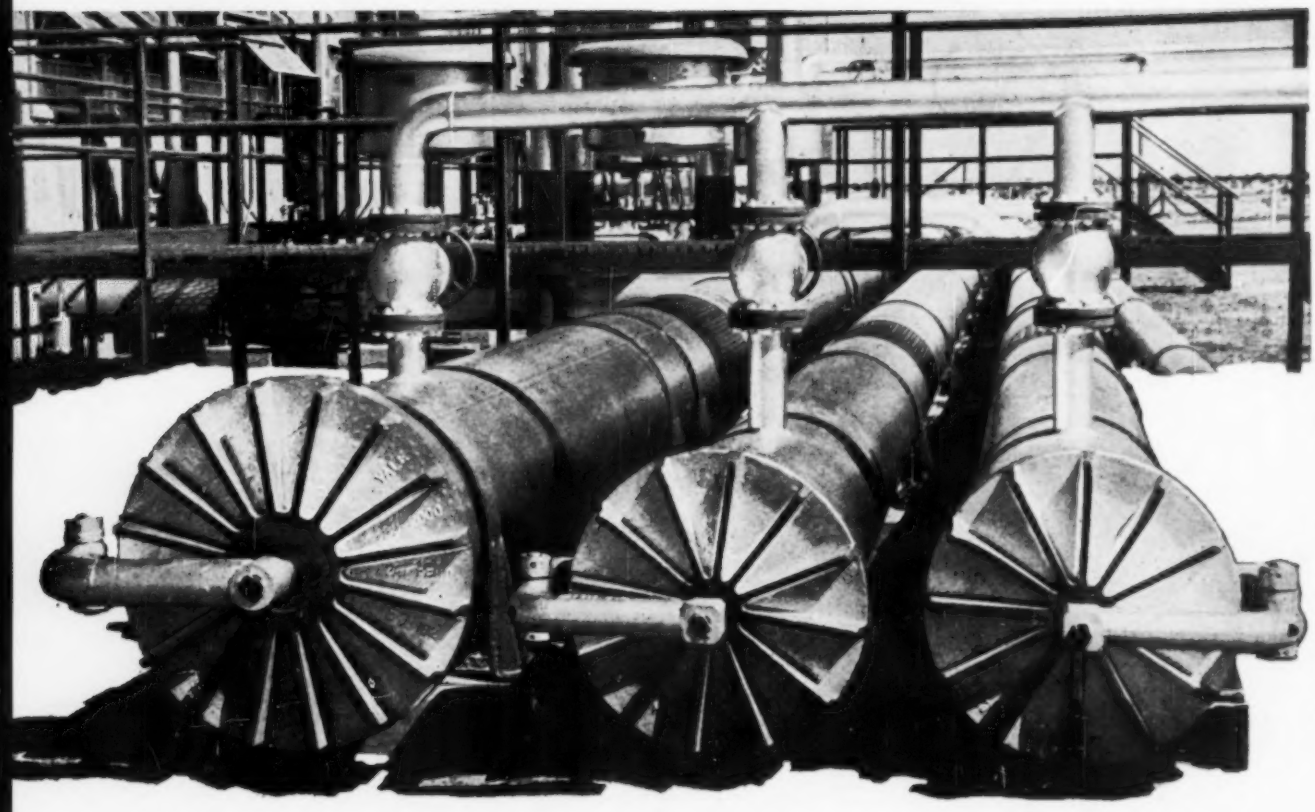

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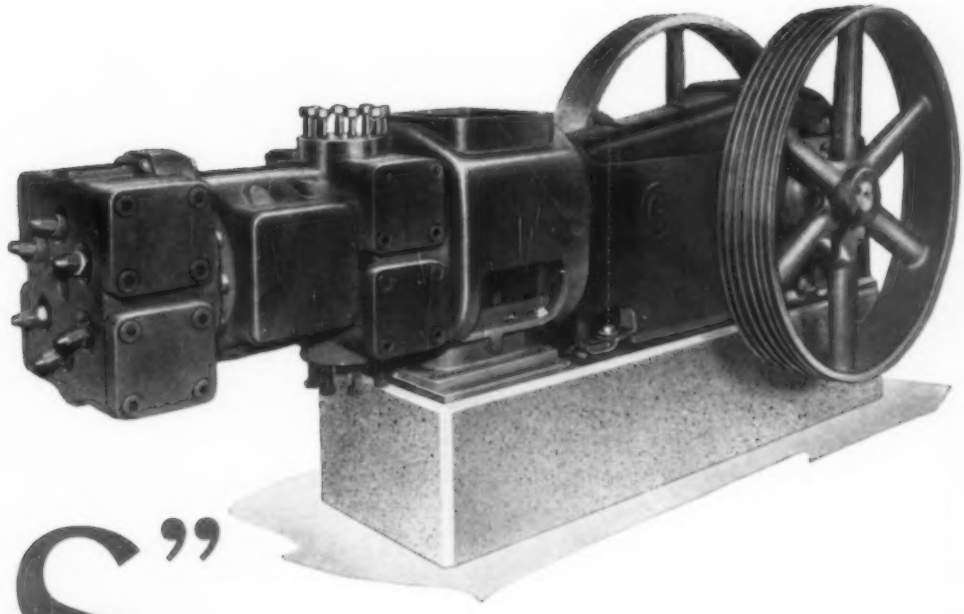


# "ES" compressors

## are the workhorses for . . .

- GAS LIFT
- FLARE GAS
- FIELD GATHERING
- REPRESSURING

Ingersoll-Rand ES compressors are widely used in oil field service. Above is one of hundreds of packaged plants built by Wilson Supply Co.

***They work, work, and keep on working*** day after day, and year after year. Ingersoll-Rand built them that way. The ES was specially designed for continuous heavy-duty service, and the reputation of thousands of units in service prove it. They last for years, even when roughing it in the oil fields.

***Attendant free . . . trouble-free . . .*** Hundreds of ES compressors are on services in the oil fields where an attendant comes around only once a day, or perhaps only a couple times a week. And when general inspection or overhaul is advisable, the Ingersoll-Rand "ES" is so easy to get at.

***Most versatile compressor you can find . .*** Above is an ES with a booster cylinder for pressures up to 1500 psi . . . specially made to meet oil field demands for versatility. Of the liner type, its construction permits a wide range of cylinder diameters without loss in performance and efficiency. You can change liners and pistons in any machine shop to meet new pressure conditions . . another reason you can get the most for your specific conditions. The ES can be belt-driven as a single unit or two of them can be combined for two-stage compression.

***When you need another compressor, be sure it's an Ingersoll-Rand ES.***

***Four stroke sizes . 20 to 150 horsepower***

**Ingersoll-Rand**

1-415 **11 Broadway, New York 4, N. Y**

# ROTARY BITS—SPEED OF OUTER EDGE AND AREA SCOURED BY BIT AT VARIOUS TABLE SPEEDS

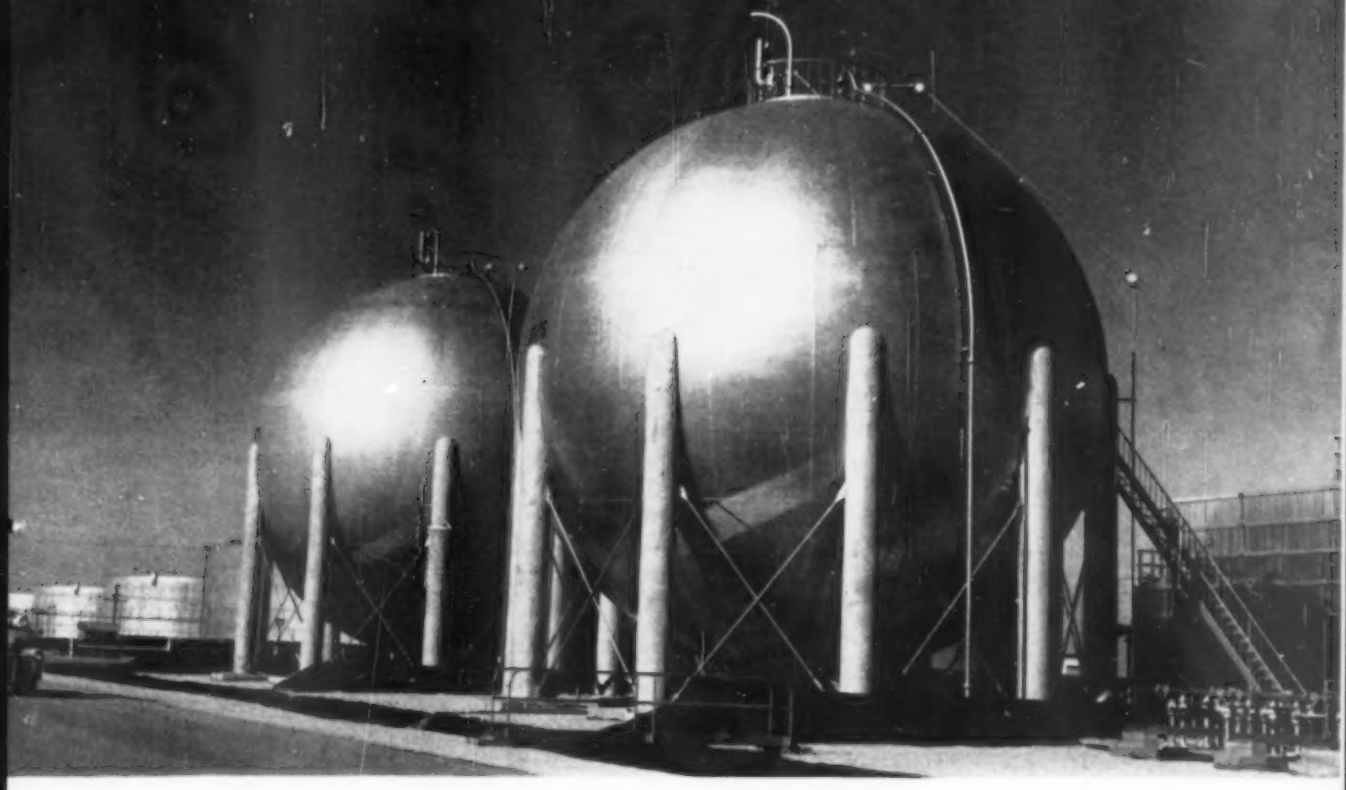
| Table speed, r.p.m. | Speed of outer bit edge, ft. per min. — Diameter of bit, in. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9⅝ | 9⅞ | 10⅝ | 11 | 12¼ | 13¾ | 14¾ | 15½ | 17 | 17½ | 18⅝ | 20 |
| 100 | 252 | 259 | 278 | 288 | 321 | 360 | 386 | 406 | 445 | 458 | 488 | 524 |
| 125 | 315 | 323 | 348 | 360 | 401 | 450 | 483 | 507 | 556 | 573 | 610 | 655 |
| 150 | 378 | 388 | 417 | 432 | 481 | 540 | 579 | 609 | 668 | 687 | 731 | 785 |
| 175 | 441 | 452 | 487 | 504 | 561 | 630 | 676 | 710 | 779 | 802 | 853 | 916 |
| 200 | 504 | 517 | 556 | 576 | 641 | 720 | 772 | 812 | 890 | 916 | 975 | 1047 |
| 225 | 567 | 582 | 626 | 648 | 722 | 810 | 869 | 913 | 1001 | 1031 | 1097 | 1178 |
| 250 | 630 | 646 | 696 | 720 | 802 | 900 | 966 | 1015 | 1113 | 1146 | 1219 | 1309 |
| 275 | 693 | 711 | 765 | 792 | 882 | 990 | 1062 | 1116 | 1224 | 1260 | 1341 | 1440 |
| 300 | 756 | 776 | 835 | 864 | 962 | 1080 | 1159 | 1217 | 1335 | 1375 | 1463 | 1571 |
| 325 | 819 | 840 | 904 | 936 | 1042 | 1170 | 1255 | 1319 | 1447 | 1489 | 1585 | 1702 |
| 350 | 882 | 905 | 974 | 1008 | 1122 | 1260 | 1352 | 1420 | 1558 | 1604 | 1707 | 1853 |
| 375 | 945 | 969 | 1043 | 1080 | 1203 | 1350 | 1448 | 1522 | 1669 | 1718 | 1829 | 1964 |
| 400 | 1008 | 1034 | 1113 | 1152 | 1283 | 1440 | 1545 | 1623 | 1780 | 1833 | 1950 | 2094 |
| 425 | 1071 | 1099 | 1182 | 1224 | 1363 | 1530 | 1641 | 1725 | 1892 | 1947 | 2072 | 2225 |
| 450 | 1134 | 1163 | 1252 | 1296 | 1443 | 1620 | 1738 | 1826 | 2003 | 2062 | 2194 | 2356 |
| 475 | 1197 | 1228 | 1321 | 1368 | 1523 | 1710 | 1834 | 1928 | 2114 | 2176 | 2316 | 2487 |
| 500 | 1260 | 1293 | 1391 | 1440 | 1604 | 1800 | 1931 | 2029 | 2226 | 2291 | 2438 | 2618 |
| 525 | 1323 | 1357 | 1461 | 1512 | 1684 | 1890 | 2028 | 2130 | 2337 | 2906 | 2560 | 2749 |
| 550 | 1386 | 1422 | 1530 | 1584 | 1764 | 1980 | 2124 | 2232 | 2448 | 2520 | 2682 | 2880 |
| 575 | 1449 | 1486 | 1600 | 1656 | 1844 | 2070 | 2221 | 2333 | 2559 | 2635 | 2804 | |
| 600 | 1512 | 1551 | 1669 | 1728 | 1924 | 2160 | 2317 | 2435 | 2671 | 2749 | 2926 | |
| 625 | 1575 | 1616 | 1739 | 1800 | 2004 | 2250 | 2414 | 2536 | 2782 | 2864 | | |
| 650 | 1638 | 1680 | 1808 | 1872 | 2085 | 2340 | 2510 | 2638 | 2893 | 2978 | | |
| 675 | 1701 | 1745 | 1878 | 1944 | 2165 | 2430 | 2607 | 2739 | | | | |
| 700 | 1764 | 1810 | 1947 | 2016 | 2245 | 2520 | 2703 | 2841 | | | | |
| 725 | 1827 | 1874 | 2017 | 2088 | 2325 | 2610 | 2800 | 2942 | | | | |
| 750 | 1890 | 1939 | 2087 | 2160 | 2405 | 2700 | 2897 | | | | | |
| 775 | 1953 | 2003 | 2156 | 2232 | 2485 | 2790 | 2993 | | | | | |
| 800 | 2016 | 2068 | 2226 | 2304 | 2566 | 2880 | | | | | | |
| 825 | 2079 | 2133 | 2295 | 2376 | 2646 | 2970 | | | | | | |
| 850 | 2142 | 2197 | 2365 | 2448 | 2726 | | | | | | | |
| 875 | 2205 | 2262 | 2434 | 2520 | 2806 | | | | | | | |
| 900 | 2268 | 2327 | 2504 | 2592 | 2886 | | | | | | | |
| 925 | 2331 | 2391 | 2573 | 2664 | 2966 | | | | | | | |
| 950 | 2394 | 2456 | 2643 | 2736 | | | | | | | | |
| 975 | 2457 | 2520 | 2712 | 2808 | | | | | | | | |

| Table speed, r.p.m. | Area scoured by bit, sq. ft. per min. — Diameter of bit, in. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9⅝ | 9⅞ | 10⅝ | 11 | 12¼ | 13¾ | 14¾ | 15½ | 17 | 17½ | 18⅝ | 20 |
| 100 | 50.5 | 53.2 | 61.6 | 66.0 | 81.9 | 103. | 119. | 131. | 158. | 167. | 189. | 218. |
| 125 | 63.2 | 66.5 | 77.0 | 82.5 | 102. | 129. | 148. | 164. | 197. | 209. | 237. | 273. |
| 150 | 75.8 | 79.8 | 92.4 | 99.0 | 123. | 155. | 178. | 197. | 236. | 251. | 284. | 327. |
| 175 | 88.4 | 93.1 | 108. | 116. | 143. | 180. | 208. | 229. | 276. | 292. | 331. | |
| 200 | 101. | 106. | 123. | 132. | 164. | 206. | 237. | 262. | 315. | 334. | 378. | 436. |
| 225 | 114. | 120. | 139. | 149. | 184. | 232. | 267. | 295. | 355. | 376. | 426. | 491. |
| 250 | 126. | 133. | 154. | 165. | 205. | 258. | 297. | 328. | 394. | 418. | 473. | 545. |
| 275 | 139. | 146. | 169. | 182. | 225. | 284. | 326. | 360. | 433. | 459. | 520. | |
| 300 | 152. | 160. | 185. | 198. | 246. | 309. | 356. | 393. | 473. | 501. | 568. | 655. |
| 325 | 164. | 173. | 200. | 215. | 266. | 335. | 386. | 426. | 512. | 543. | 615. | 709. |
| 350 | 177. | 186. | 215. | 231. | 286. | 361. | 415. | 459. | 552. | 585. | 662. | 764. |
| 375 | 189. | 199. | 231. | 248. | 307. | 387. | 445. | 491. | 591. | 626. | 710. | |
| 400 | 202. | 213. | 246. | 264. | 327. | 412. | 475. | 524. | 631. | 668. | 757. | 873. |
| 425 | 215. | 226. | 262. | 281. | 348. | 438. | 504. | 557. | 670. | 710. | 804. | 927. |
| 450 | 227. | 239. | 277. | 297. | 368. | 464. | 534. | 590. | 709. | 752. | 851. | 982. |
| 475 | 240. | 253. | 292. | 314. | 389. | 490. | 564. | 622. | 749. | 793. | 899. | |
| 500 | 253. | 266. | 308. | 330. | 409. | 516. | 593. | 655. | 788. | 835. | 946. | 1091. |
| 525 | 265. | 279. | 323. | 347. | 430. | 541. | 623. | 688. | 828. | 877. | 993. | 1145. |
| 550 | 278. | 293. | 339. | 363. | 450. | 567. | 653. | 721. | 867. | 919. | 1041. | 1200. |
| 575 | 291. | 306. | 354. | 380. | 471. | 593. | 682. | 753. | 906. | 960. | 1088. | |
| 600 | 303. | 319. | 369. | 396. | 491. | 619. | 712. | 786. | 946. | 1002. | 1135. | |
| 625 | 316. | 332. | 385. | 413. | 512. | 645. | 742. | 819. | 985. | 1044. | | |
| 650 | 328. | 346. | 400. | 429. | 532. | 670. | 771. | 852. | 1025. | 1086. | | |
| 675 | 341. | 359. | 416. | 446. | 552. | 696. | 801. | 885. | | | | |
| 700 | 354. | 372. | 431. | 462. | 573. | 722. | 830. | 917. | | | | |
| 725 | 366. | 386. | 446. | 479. | 593. | 748. | 860. | 950. | | | | |
| 750 | 379. | 399. | 462. | 495. | 614. | 773. | 890. | | | | | |
| 775 | 392. | 412. | 477. | 512. | 634. | 799. | 920. | | | | | |
| 800 | 404. | 426. | 493. | 528. | 655. | 825. | | | | | | |
| 825 | 417. | 439. | 508. | 545. | 675. | 851. | | | | | | |
| 850 | 430. | 452. | 523. | 561. | 696. | | | | | | | |
| 875 | 442. | 465. | 539. | 578. | 716. | | | | | | | |
| 900 | 455. | 479. | 554. | 594. | 737. | | | | | | | |
| 925 | 467. | 492. | 570. | 611. | 757. | | | | | | | |
| 950 | 480. | 505. | 585. | 627. | | | | | | | | |
| 975 | 493. | 519. | 600. | 644. | | | | | | | | |

**Remarks:** Often in drilling-time studies of different size bits, it is desirable to correlate the data in terms of the peripheral speed of the bit and of the effective area of hole traversed by the entire face of the bit. The above table is designed as an aid in such studies.

# HORTONSPHERES...

## shaped to fit volatile hydrocarbon storage requirements



Volatile hydrocarbons require storage under pressure to prevent excessive evaporation loss. Hortonspheres® are designed and shaped to withstand internal pressure. No vapor can escape as long as the internal pressure does not exceed the setting of the pressure relief valves.

Hortonspheres are built in standard capacities to 30,000 bbls. and for pressures up to 217 lbs. per sq. in. in the smaller sizes. They are used extensively for the storage of the more volatile grades of natural gasoline, butane, butane-propane mixtures and refinery stocks.

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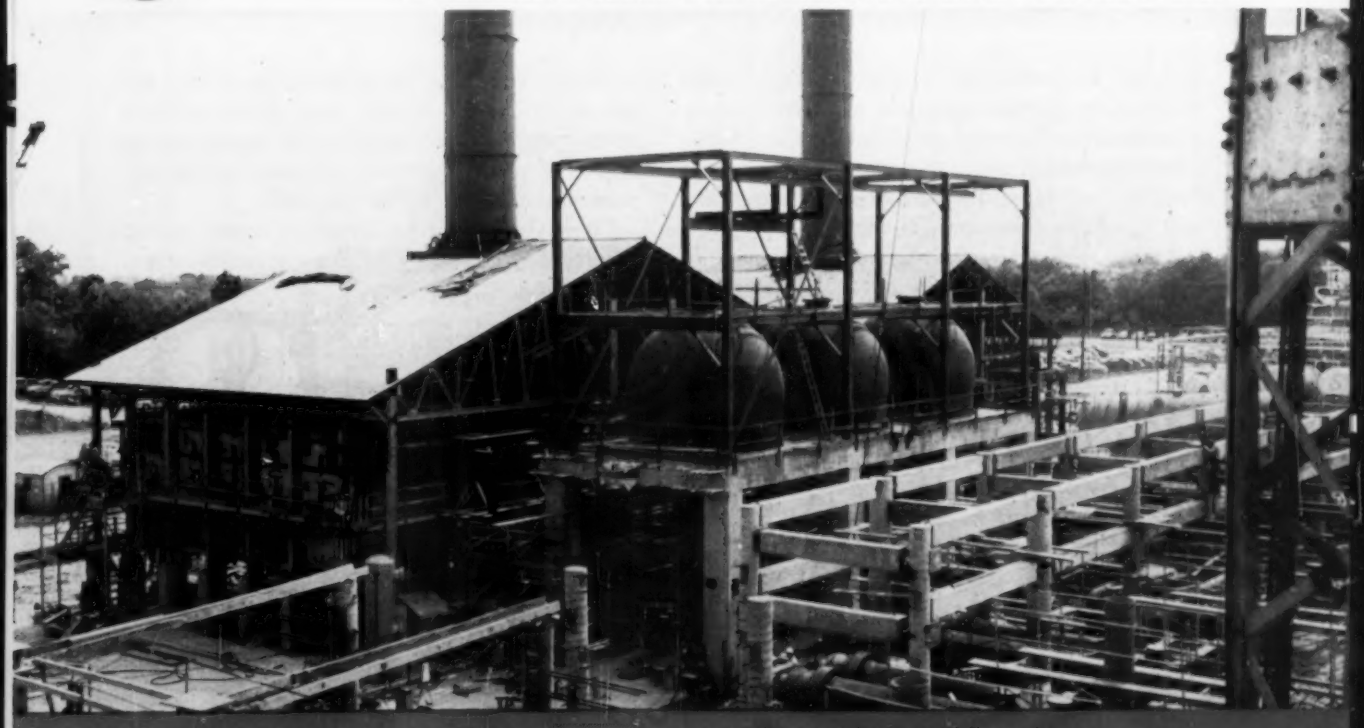

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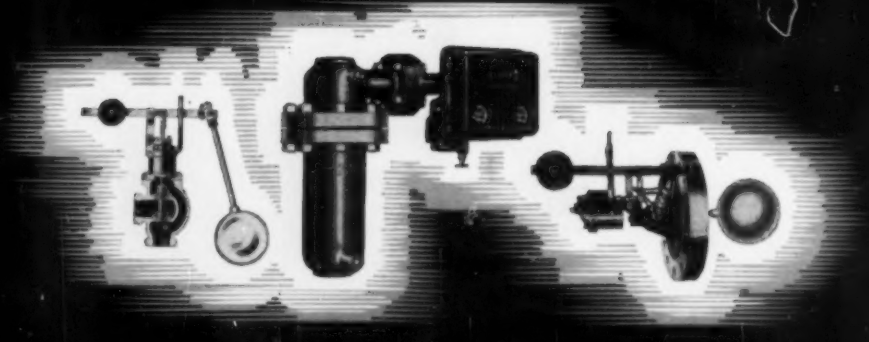

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**Said Opinion Surveys: 40 per cent of today's ministers are sharply critical of business, maintaining there is inherent conflict between business and Christian principles . . . Carter Oil met this with a series of Clergy Days**

**R. D. Sloan** shows how Carter's dollar of income is spent.

# Clergy Takes a Look at Oil

A concise matter-of-fact review of how a typical American oil company operates — its aims, its goals, its problems — was given 81 ministers of Denver, Colorado, October 18, 1956, when The Carter Oil Company was host to members of the clergy at a noon luncheon at the Cosmopolitan Hotel.

This was Carter's fourth Clergy Day event and the first in which a representative of every church organization in a city was invited to attend.

Meetings such as the Denver affair were inaugurated by Carter after national public opinion polls revealed:

**That 40 per cent of the ministers today are sharply critical of business, maintaining there is an inherent conflict between business, as it exists today, and Christian ideals and principles.**

**That 44 per cent of the ministers interviewed said industries make too much profit.**

**That 39 per cent said our business system today reduces the employee to the status of cogs in a machine and that labor unions are far more concerned with welfare of employees than are companies.**

**That 77 per cent of the ministers said businessmen should do more to acquaint the clergy with their business problems.**

With this premise and challenge, R. D. Sloan, Denver, western division manager for Carter, conferred with Reverend Harvey Hollis, Denver, executive secretary of the Denver Area Council of Churches, to select a date. Invitations sent to each minister or chaplain made it plain the meeting was intended as a forum where both business and clergy might exchange ideas and have an opportunity to view and discuss and better understand each others' problems. Invitations stressed that the purpose of the meeting was to explain how a typical American oil company operates.

The ministers were greeted on arrival by Sloan and other representatives of Carter's western division. Guests were seated at tables for seven, with a Carter man in each group. There was no head table.

After the invocation, Sloan welcomed the churchmen, emphasized the meeting would be adjourned by 3 p.m. but pointed out his people were prepared to remain there as long as there were questions.

After lunch, John Cook, western division exploration manager, spoke of the finding and producing of crude oil. He mentioned business relationships of the so-called majors and independents and the contributions of both to a healthy industry. He told the difficulty of finding new crude reserves and the tremendous competition that exists in seeking leases in new oil areas.

Sam Whitehill, western division marketing manager, described the role of the "corner service station operator" in business life today. He spoke of gasoline price wars and related factors that govern the price of gasoline.

Sloan concluded the formal presentations. A large scale pie chart was used to show how Carter's dollar of income is spent. Profits, depreciation, taxes, payments to employees were among the distribution categories stressed. Oil industry profits were compared with those of other industries. Decentralization, employee benefits and opportunities for advancement were emphasized.

Concluding his remarks, Sloan invited comments from the church leaders. Some typical inquiries were:

**1. Do employees being evaluated know where they stand or does the company keep this information to itself?**

**2. Is it true that state laws require so much octane in gasoline?**

**3. Is atomic energy going to supplant gasoline as a fuel in the future?**

**4. Explain the oil companies' attitude in connection with passage of the natural gas bill.**

**5. How can some service stations honor all credit cards when others will honor only cards from certain companies?**

**6. Why are Murchison and other Texas oil men so wealthy — do they get that way over the 8 per cent profit that you show on the chart?**

**7. Does Carter support charitable and educational institutions?**

**8. How can one company claim it has the best gasoline?**

More than 30 questions were asked by the ministers. After adjournment of the formal session, one-half the guests remained for discussions and questions for another hour. Coffee was served.

Packets of materials on careers in the oil industry, literature put out by the American Petroleum Institute, and pertinent Carter pamphlets were made available to the ministers.

Specific requests for information and material came from some of the guests. One inquired concerning availability of motion pictures on the industry, two wanted literature explaining Carter's methods of screening and evaluating work of personnel, another wanted data on recruiting methods used by the industry.

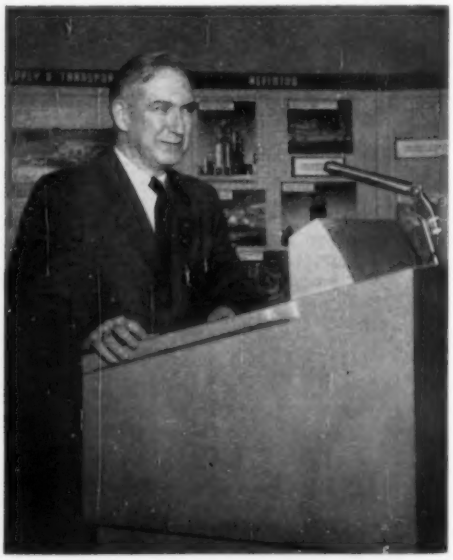
The enthusiastic and unrestricted manner in which the clergymen questioned Carter hosts and their insistence on detailed answers seemed indicative of genuine interest. ★ ★ ★

*Ohio Oil Promotes Fuller Understanding of the Company and the Oil Industry Through* **NEW EMPLOYEE**

# ORIENTATION

WHEN NICK NEWHIRE joined The Ohio Oil Company several months back as a clerk in the general office, he naturally had a good many questions about his job, his future, and about the operation of an oil company.

Newhire felt that he needed answers to these questions in back of his mind as they vitally affected him. And what's more, he needed to know in order to answer his friends, neighbors and relatives when they asked about his new job and new company.



E. H. Backey, general office manager, welcomes the 28 members of the 18th orientation class.

Answers to questions like:

How did our company begin? or What and who make our company tick? or How is oil produced, transported, refined and marketed? or How does our company fit into the entire industry picture? or Who owns our company?

But probably most important to Nick were questions like:

How will I know how I'm progressing with the company? or How does my clerking job fit into the whole company operation?

The answers to these questions make Nick's job more meaningful to him. They show him that his is not a routine job lost among the more than 6600 other jobs in the company, but his job is in reality a vital operation working hand-in-hand with the others to benefit all 6600 men and women Newhires and Oldhires.

Being provided with these answers makes Newhire feel he is a member of The Ohio Oil team and he is a better employee for it. The general office orientation program does just that. Since its beginning in April 1951, the program has provided the answers for 630 Nick Newhires.

Held about every three months or four times a year depending on the new employee flow, each program lasts 10 days and consists of daily classes averaging an hour to an hour and a half in length. Each new employee is invited to attend orientation after he has been with the company about three months. This gives him time to become adjusted to his new position and by this time, questions similar to Nick Newhire's begin to crop up. By then, he may want to brush up on the details and provisions of the various benefit plans, as they may

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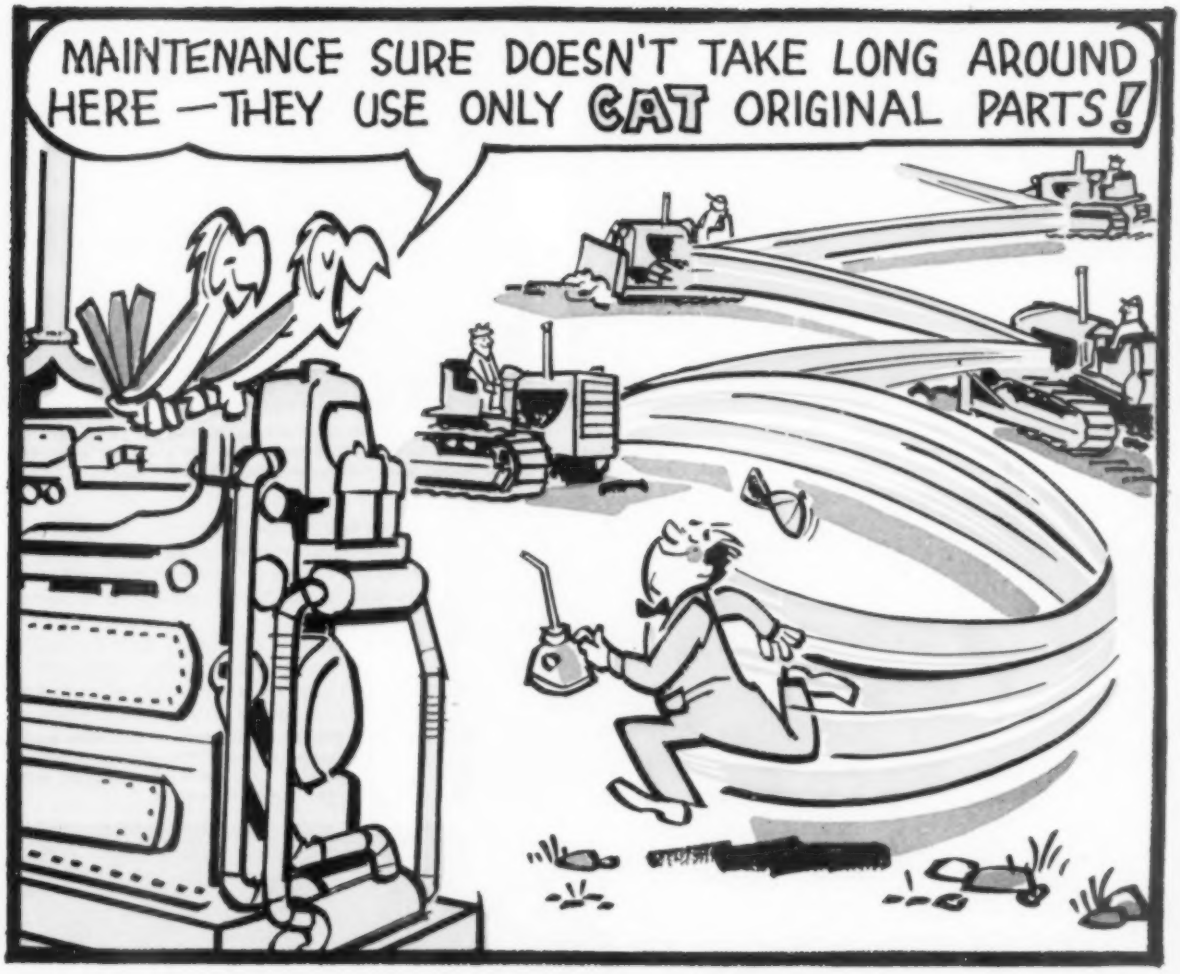
Editor's Note: Reprinted from *The Beacon*, employee magazine of The Ohio Oil Company, Findlay, Ohio, now in its 22nd year. Eugene L. Price is editor.



An engine bearing—not big, but mighty important. If it's a CAT® bearing, it's an *exclusive combination* of aluminum alloy—extra strong with just the right degree of hardness. But if it's a "look-alike" bearing—who knows?

Be sure to get parts you can trust—from your Caterpillar Dealer. He always has the *exact* part you need. Play it safe—don't be fooled by "look-alikes."

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

**CATERPILLAR***

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Members of the general office personnel department map out the current orientation procedure. Supervisor Don Wilson, Assistant Supervisor Bob Trace, Personnel Representatives Anne Lytle, Gene Slough, Norm Meyers.

Anne Lytle, standing at right of map, presses the button that lights up The Ohio Company's continent-wide operations for Janet Bright, Denise Scales, Shirley Montz and Carol Scothorn (right).

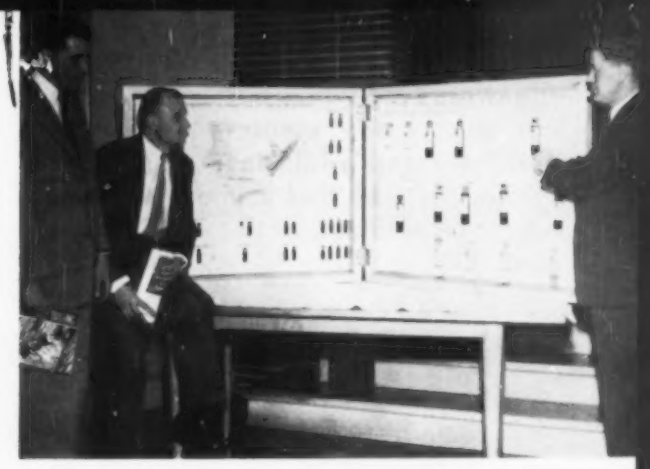
Tour of general office facilities brings the class to the tabulating department, where Les Eaves *(right)* describes the operation of the 650 data processing machine.

Bill Currie, assistant general office manager, *(center)* discusses "the employee's potential," dealing with employee education, progress reports, and promotions.

Gene Slough makes clear some specific provisions of the benefit plans for Ralph Tabor, William Hegemier and Mary Slack.

Norm Meyers discusses a final point with Donald Fallas, Larry Miles, Paul Jackson, Hillary Youngpeter. Slides make a graphic presentation.

Bob Trace shows John Leark, John Burger and Elton Reneau the fishtail bit from our discovery well at Haynesville, Louisiana. Pictures, booklets and displays of tools bring practical knowledge to new G. O. people.



Bob Trace points out representative U. S. crude oil samples to James Koeller and Roy Lessing. Ohio's *Deep Rotary Drilling* booklet describes the technique of drilling for these crudes with modern rotary tools.

have become a bit hazy since his first day at work when the plans were first outlined briefly. Since the first classes in 1951 when there were about 15 members per class, the number has grown to an average of 40 to 50 new employees seeking vital answers.

General office orientation is quite original among industries in the extensiveness of its subject matter. The orientation procedure includes 11 basic steps: (1) history and scope of the company and the oil industry, (2) company organization, (3) finance, (4) conducted tour of the general office, (5) company benefits, (6) producing oil and gas, (7) supply and transportation, (8) refining, (9) marketing, (10) your job and getting ahead, (11) meeting company officers and directors at luncheon.

The discussions are carried on in an informal, instructional manner and are open for questions at all times. Technical subjects are discussed in layman's terms. Movies, vugrams, booklets and displays bring the class members closer to actual field activities. New subjects are continually introduced and old ones revamped to maintain an up-to-date picture of company and industry operations.

Practice has been for class members to evaluate the program through anonymous questionnaires. This provides a yardstick for determining whether orientation is covering all new employee questions. These questionnaires show the program to be helpful and worthwhile in showing company and industry structure, basic fundamentals of the oil business and the coverage of our benefit plans. Nick Newhire and all other employees can rest assured that our company stands ready to answer any question they may have. ★ ★ ★

Model rotary rig and pumping jack bring actual field operations closer to Peggy Ramsey and Karen Augsburger.

Dona Griffith, Gene Smith and Janice Schutz examine a scale-model cable-tool rig. Constructed by Ron Bower of office services department, this model demonstrates operations of a full size rig.

Importance of safety in the office as well as in the field is pointed up in orientation. Here, Gene Slough demonstrates a safety hat to Kay Bell, Carol Hetrick and Robert Whitesell.

EXCLUSIVE

Who does the organizing, planning and directing of new plants and facilities, alterations and additions? You may be surprised to find that in most petroleum and chemical firms . . .

# Company Engineers Handle Most Problems

Carl W. Barkow

IT was the purpose of a study to determine to what extent the chemical and petroleum industries utilize the Engineering Division through the Project Engineering Department and the Project Engineer (or their equivalent) in the organizing, planning, directing, and controlling of the following expansion programs and projects (those that are capitalized) from their authorized inception to completion:

1. New plants, process units or buildings.
2. Alterations and additions to an existing unit or building.

Also to determine the Project Engineer's authority, responsibilities, qualifications, and characteristics.

## Scope

A questionnaire was directed to the major companies of the petroleum and chemical industries that would normally include an Engineering Division in their organization that is responsible for the design, procurement and construction of new plants and buildings, and additions and alterations.

The petroleum industry was limited to the refining, petro-chemical and gasoline plant divisions, while the chemical companies excluded the food and basic metals industries and chemical equipment manufacturers.

## Results of Survey

Of the 232 questionnaires sent out, 117 replied, representing 98 different chemical and petroleum companies.

Of the 95 that answered the questionnaire, 23 came from companies with less than 1000 employees, 38 with 1000 to 5000 employees, and 34 with over 5000 employees. (Note: Breakdown of company size is the author's.)

Size of the Engineering Division showed 41 companies with less than 25 technical employees, 31 had between 26 and 99, 11 with 100 to 300, and 8 with over 300.

## Organization

Important to any division in an organization is the status it holds within that organization. The Manufacturing Division **always** has its status in general management (reports to president); also in this day of emphasis on labor relations and union negotiations, the concerned division enjoys equal status in general management as does the Manufacturing Division. However, the Engineering Division does not enjoy this status. This study indicated that only one-third of the Engineering Divisions had their status in general management, the remainder were in divisional and departmental levels of management. A National Industrial Conference Board Report,[1] including all types and sizes of industries, showed that 24 of the 53 companies' Engineering Division surveyed had its status in general management while 51 and 48 companies gave general management status to their Manufacturing and Industrial Relations Divisions respectively.

It is not unusual for Engineering Divisions of the major refining and chemical companies to have their Engineering Divisions report to the plant superintendent or manager.

All companies replying indicated their use (naturally to various degrees) of company engineers in the design, procurement and construction of new plants and buildings, and additions and alterations. The authority and responsibility given these Project Engineers varied considerably. Of the 61 companies that stated they gave the Project Engineer complete authority over the project from its inception to completion, only 20 of the company's organization charts reflected this authority and responsibility. One can only surmise in the others that this authority may have been delegated, spelled out in job description or standard procedures, was given by assignment, or perhaps it might have even been implied.

Size of company was apparently not a factor in this delegation of responsibility.

## Participation in Expansion Programs

The extent to which the company Engineering Division participated in the expansion programs quite naturally varied widely.

Only in 6 companies, did the Engineering Division **not** participate in the design of new units, while 19 companies performed all the design. For alterations and additions, only 3 companies did less than 50 per cent of the design work and 48 companies did 100 per cent.

## Procurement

All but 11 companies assisted in the procurement of equipment and materials for new plants and participated to a greater extent in the procurement of materials for additions and alterations.

While this procurement was generally handled by a separate division, the Engineering Division prepared specifications, made recommendations, and assisted the Purchasing Division in expediting these materials. On large projects, the Purchasing Division assigned men to the job for the duration of construction.

**Editor's Note: This article is based on the results of a survey (September, 1955) of the petroleum and chemical industries by the author for partial fulfillment of the requirements for an MS in business administration at the University of Tennessee. He is now with Union Carbide Nuclear Company in the Oak Ridge Gaseous Diffusion Plant.**

[1] *Company Organization Charts*, National Industrial Conference Board, New York City, The Conference Board, 1958.

# NATIONAL'S NEW "COG" SEPARATOR

*COG—Conservation of Oil and Gas. COG is the trademark of National Tank Company. Patent Applied For.

## WHAT THIS SEPARATOR WILL DO FOR YOU:

### PROBLEM:

Operate low pressure oil-gas separator at normal predetermined pressure, yet have sufficient pressure at any time to push oil through lines into tanks. Required that no gas vent oil carry-over will occur.

### SOLUTION:

**Install a new National "COG" Separator with dual controls and reap these benefits:**

- With near zero psi on separator at time well intermitter opens the flow valve, there is a greater pressure differential across the well head, permitting greater benefit of entrained and dissolved gas in the tubing by at least one atmosphere of expansion. This acts to unload the well more quickly or give the well a longer flow life.
- For gas lift wells, less gas will be required, thus reduce such cost of producing.

**The "COG" operating pressure does not start upwardly until the oil reaches the separator and causes the float to rise, automatically adjusting the gas valve to only that pressure necessary to push the oil to tanks.**

- Sometimes a pumping well will flow for a time after the fluid head is pumped off. When this happens, a tremendous head of oil will "hit" the separator. If enough back pressure is held on the separator to prevent carry-over at times when the well heads, at all other times the unnecessary higher pressure reduces the tendency to flow, reduces the pump efficiency, and causes faster rate of wear on stuffing boxes, etc.

**But, if a "COG" Separator is used, when only 10 psi is needed on the separator, it's there automatically; when 40, 50 or even 100 psi or more is required, it's there too, automatically.**

- Many oil wells flow by heads. If the normal operating pressure of an oil-gas separator is 25 psi, and the back pressure is not sensitive to oil level within the separator, then the obvious occurs when the oil head "hits" the separator. As high as two barrels of oil may go out the separator gas vent for big heads of oil.

**But not so with a "COG" Separator. A minimum predetermined pressure can be set with the controls. If the fluid rate becomes too high for normal operating pressure, causing a rising fluid level in the "COG" Separator, the "COG" dual controls automatically increase the back pressure to that required to move the oil. Such increased back pressure moves the oil out of the separator at a faster rate and tends to restrict the inlet rate also, but ONLY during the time of excessive flow into the "COG" Separator.**

- Sometimes lease storage tanks are connected together and to the separator with larger than necessary pipe and fittings such as 3" in place of 2", so that when heading flows are produced through the separator, downstream restriction that might cause flooding in the separator is minimized.

**When using the "COG" Separator, extra large size lines to the tanks are not needed; because if increased pressure drop occurs in the line from separator to tanks (such as may be caused by higher flow rates, increased viscosity due to lower temperatures, partial vapor lock, partial filling of line with water, or other cause) the level will rise in the separator and automatically create higher pressure to compensate for the increased pressure drop.**

- All additional savings, increased revenue and operational advantages are yours at no extra cost when the National "COG" Separator is on the job.

*"ANOTHER FIRST"*

**National Tank Company • Tulsa, Oklahoma**

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## HELP MAKE ANY OIL OR GAS LINE INSTALLATION EASIER, QUICKER, LOWER IN COST

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1. It bends readily
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### Construction

In the building of new plants, 49 companies stated that outside contractors did all the work. An additional 28 companies had 75 per cent of the work performed by outside forces, and only 7 companies did all their own new construction.

Contrasting this with additions and alterations, only 8 companies contracted all of their work and there was almost an equal division of the remainder between 25, 50, 75 and 100 per cent.

There was no discernible relationship between company size and the amount of new construction work performed by the company's own forces.

### Consulting Engineers

In determining the use of consulting engineers by these companies, it was observed that nearly 70 per cent of the Engineering Divisions **did not** use consulting engineers and another 10 per cent only "sometimes." Since the greater majority of these were large companies with engineering staffs, it probably follows that they either have sufficient engineering talent available or readily available from other company's sales and service engineering departments that were interested and concerned with the problem from a purely monetary consideration.

It also appears that the consulting engineer derives most of his revenues from the smaller companies without engineering staffs to handle all problems.

### Duties and Responsibilities

Authority and responsibility relationships are always important in an organization, and in the case of the Project Engineer, it seems even more important for his duty takes him across organizational lines in administering any project.

It is pertinent that this authority be spelled out and understood in order that all other groups may know what relationship exists between the Project Engineer and the individual group concerned with any phase, regardless of the amount of participation, of the project.

As stated before, 61 companies gave the Project Engineer complete authority for the job from its inception and authorization to completion. However, in only 20 company organization charts was this reflected.

Company size again appears not to be a criterion in the determination of whether the Project Engineer should be given this authority or not.

From a tabulation of the various phases of management functions over which the Project Engineer was given full authority, the following items listed were considered pertinent and of interest:

1. Purchasing was generally handled by a separate division.
2. Twenty-eight of the 61 companies gave the Project Engineer full autnority over all phases of the project. An additional 12 had authority over the design and construction phases, another 16 over design alone and 8 more over the construction phase. The remaining companies gave authority and responsibility over various phases with emphasis on scheduling, design, planning, budget and cost control, and quality of work.
3. A remarkably large number of companies — 40 — gave the Project Engineer the responsibility of acceptance tests.
4. Not all Project Engineers were involved in the paper work.
5. The one-third of the companies that limited the Project Engineer's responsibility and authority, did give the Engineer a "few" phases over which he exercised authority. These were varied but again design and construction were emphasized. It was noticed that many only gave partial authority and responsibility, whatever that may entail. This partial delegation probably points up the apparent difficulties and frustrations in the Project Engineer's effort to get the job done. The probabilities are that in order to get the job done, he must rely, to a great extent, on all the personalities and salesmanship he possesses to get the people concerned with the problem to cooperate and assist him.

### Policy on Decision

In defining the scope and manner by which the project is to be completed, over 85 per cent of the companies stated that final decisions were made by group action rather than by the division concerned. The major decisions were in the fields of initial planning, broad scope, major policies, and design criteria.

These results were not surprising but emphasized the current practice of decision making by group action of those concerned with the project. Whether group action was obtained by formal committees, meetings, conferences, or other means, was not queried in this study.

### Budget Limitations

Over 90 per cent of the companies applied budget limitations on the Project Engineer. Those that imposed no limitations were mainly from companies with less than 100 employees. The limitations imposed can be classified in the following categories (number of companies concerned follow):

| | |
|---|---|
| Prior approval before exceeding amount authorized | 15 |
| Within 10 per cent (or a certain figure ot the established cost or amount authorized | 26 |
| Required to stay within estimate and overruns and underruns require justification | 28 |
| Government limitations and approval | 4 |

Again company size was apparently not a factor in these limitations.

### Organizational Problems

The question on what measures are taken to insure: (1) The integration of the various engineers on the project, (2) team work and communications, (3) prevention of one overlapping of duties, and (4) empire building, produced varied answers from the 60 companies that replied. A brief summary (verbatim replies) of these problems follows: The replies included, in all cases, the range from "no problem" to a very definite and finite action to solve the problem:

1. To insure the integration of the various engineers connected with the project.
   "By developing competent Project Engineers and by an overall supervision of their work by the manager — a good Project Engineer will surround himself with the best of talents in fields where he is weak — training, effective supervision and rotational assignments."
2. To insure team work and communications.
   "How the team operates is a matter of administrative judgment of the Project Engineer — communication and maintenance of 'esprit de corps.' Project Engineer coordinates all activity and must report progress periodically and issue schedules for the completion of the project — no problem."
3. To prevent overlapping of duties.
   "Chief Engineer and Project Engineer collaborate in the work assignments and scheduling — there is little chance for overlapping of duties because of a normal state of affairs, projects are run with a minimum number of people. They are bound to overlap in spite of everything — some overlapping is condoned, or even encouraged, so there will be no no-man's land of duties."
4. To prevent empire building.
   "Empire building is prevented

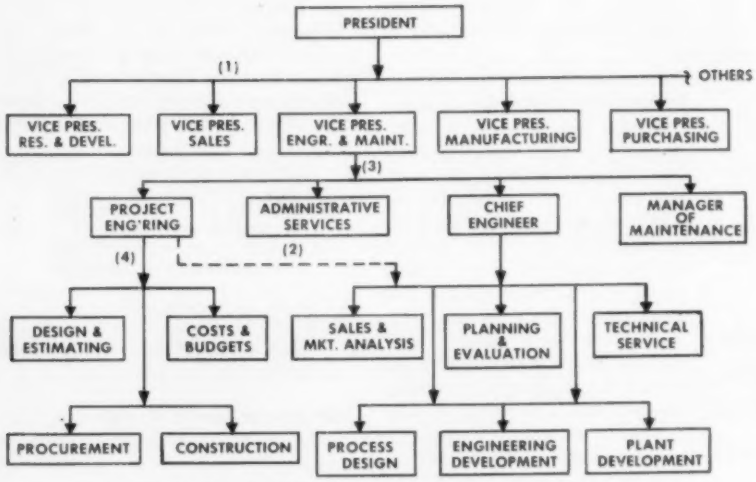


FIG. 1. Proposed Engineering Division Organization.

through the administrative direction of the Director of Engineering — keep them too busy — no group is allowed to remain intact from job to job — no problem — close observation by management and strict budgeting of dollar and manpower — approval of project and certain work orders and employment level by technical management."

### Savings Experienced

Almost all companies stated that Project Engineering as a management tool has saved the company time, effort, and monies in completing the expansion programs. The areas in which the savings were experienced are listed below and are in order of importance:

1. Coordination of design.
2. Scheduling.
3. Field coordination and construction.
4. Determination of scope of the project.

### Qualifications and Characteristics

From the information received on these subjects, it appears that one may set forth the qualification and characteristics of a typical, average desirable (or whatever you may choose to call it) Project Engineer in the chemical and petroleum industries.

He is about 35 years old (although it is common to have men in the range of 45-65 if they are physically able to handle the job), he has either a chemical or mechanical engineering degree and was an average student at college. His ten years experience has been in the fields of engineering and process design, operations, maintenance and construction, and he may have spent some time in research and development. Only one of three Project Engineers has received any formal training and then to a limited degree in the fields of planning, organization, budget control, and human relations.

Chances are, 2 to 1, that he works for a company that gives him full control of the projects that are assigned to him. His average[1] salary of approximately $9600 per year is generally above that for his age and experience as compared to all other engineers.

He is a man of keen personal and professional integrity, possesses common sense and good judgment along with a well developed ability to think clearly and logically. He must have initiative and the corresponding physical ability to handle the job. He must be able to organize men and facilities to translate these plans and ideas into action and possess the ability to make decisions and to stand behind them.

### Organization Structure

Results of this study showed a definite need for a project engineering organization that will effectively and efficiently perform the prime objective, namely, the building of plants. To reiterate, in reviewing the organizational charts of the 61 companies, or 64 per cent, that gave the Project Engineer complete authority for the completion of the project, it was observed that in only 20 of the companies' organization charts was this reflected, in 12 this was not discernible and in 29 it could not be determined the manner in which the Project Engineer received authority to administer the project from its inception to a successful conclusion. One can only surmise that the responsibility may have been delegated, spelled out in job description or a standard procedure, by assignment, or perhaps it may have been implied.

Also, of the 61 companies, or 64 per cent, who stated they gave the Project Engineer complete authority, only 27 gave him the authority over all phases of the project except purchasing and expediting. Forty of the 95 companies replied that they gave the Project Engineer the responsibility for the design and construction of new facilities. An additional 16 listed the Project Engineer as having the responsibility of the design only, and 9 of the construction phase only. There were 6 no answers.

With these results and the author's experience and closeness to the field, it was evident that a need existed for an organization structure that would allow the project engineering group to administer efficiently and expeditiously the project from its inception to completion.

The author realizes the vast number of possibilities that exist in setting up a project engineering organization, describing its functions, responsibilities and duties and in the specification of the men to staff and run the organization. Therefore, the following information should be considered "typical and desirable."

Every organization exists to accomplish a purpose, which should be

1. Clearly defined or imagined, or both
2. Understood or accepted by those in the organization.
3. Considered worthwhile[2]

In the case of project engineering, the purpose is the building of plants.

The manner and mode in which the engineering division is authorized to proceed with the building of new facilities is many and varied. It may come from the board of directors (usually in the case of large expansion programs), the operating committee, the executive committee, the president or from the division concerned.

Along with this authorization from top management is the obligation of the engineering division to report back to these levels of management on the progress of the program and to keep the group informed of the major items that may affect capital outlay, costs, and operations.

Preliminary estimates and engineering studies may be requested before the authorization of any project. This work may be performed by a special group or by the engineering division to assure management that the proposed project is economically feasible and that market conditions are such to provide a quick payout. Also, that all other factors are in line with good manage-

[1]This is not a weighted average, but an average of ranges submitted with the questionnaire.

[2]Catheryn Seckler Hudson, *Process of Organization and Management*, (Washington, D. C.: The American University Press, 1951), p. 49.

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You've come to expect *extra work capacity* in Koehring machines — and you get just that in the new 405, heavy-duty leader in the 1-yard class. On hoe applications, it digs 43 inches wide over side-cutters — 22½ feet deep. Long reach puts spoil bank well beyond edge of cut — and gives 12½-foot clearance height (at beginning of dump) for truck loading. Cutting angle is adjustable to suit digging conditions. Equalizer at dipper assures even pull on each cable.

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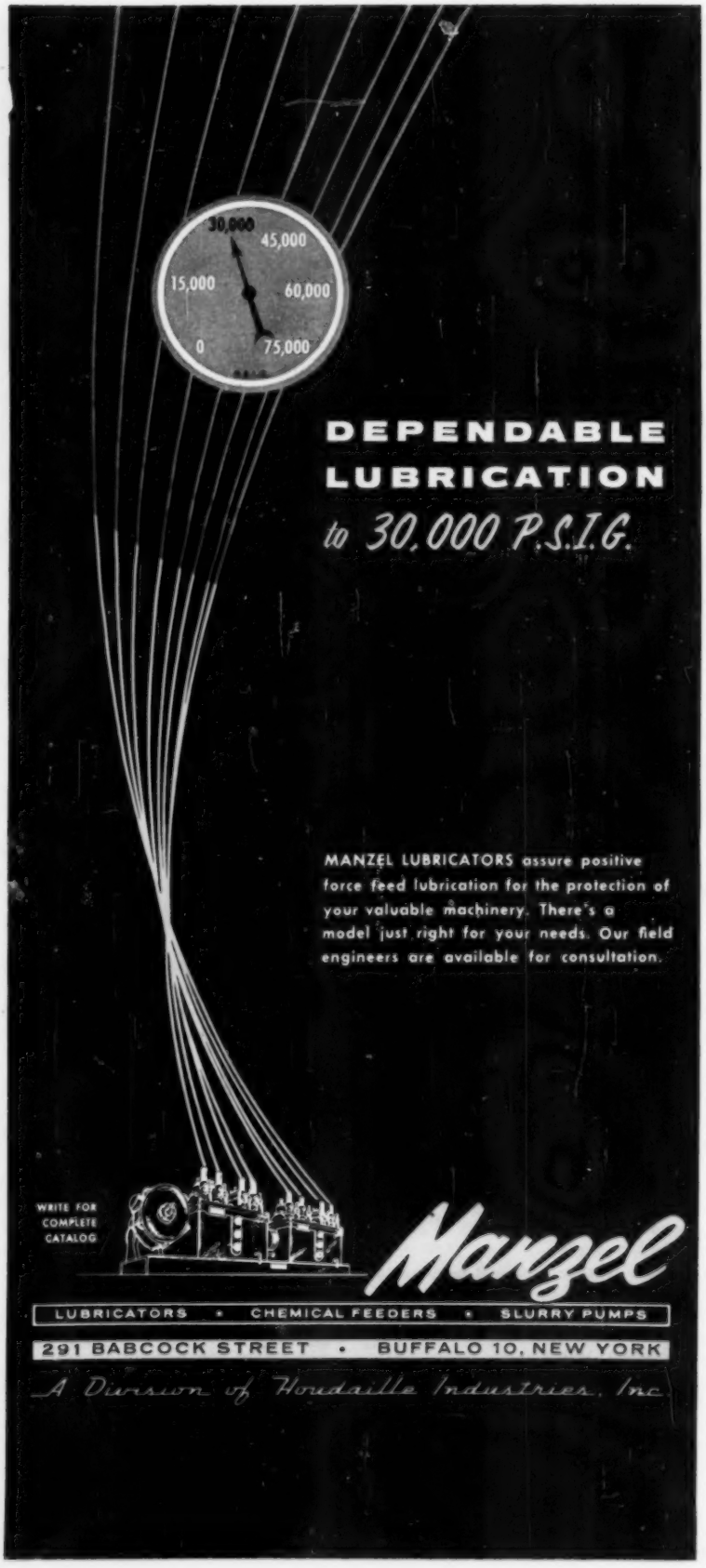
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ment practices and engineering procedures.

The project or program is then formally announced by top management to all divisions of the company and the Project Engineer assigned from the engineering division to direct the work. From here the organization structure as shown in Fig. 1 takes over. The following numbered notes refer to the numbers on the organization chart and, in general, set forth the "mode operendum" of the project:

Note 1. These divisions will be called upon to perform various functions necessary for the project and will assist the Project Engineer in these functions and work under his general direction on matters pertaining to the project.

Note 2. These groups are under the administrative direction of the manager of engineering but under the technical direction of the Project Engineer when assigned to the project.

Note 3. The Project Engineer will, of necessity, delegate the responsibility of various phases to other groups. However, he still maintains the overall responsibility for the project and the final decisions of all matters rest with him. These groups are obligated to keep the Project Engineer informed of the group's activities and progress.

Note 4. The mechanics, procedures, standards, and paper work in administering the project will not be considered as they are too detailed and variable.

Projects of lesser magnitude originate directly from the other divisions and departments in the form of a formal request of the engineering division to provide any and all of the following type services: Preliminary investigation, cost estimates, development programs, complete turn-key jobs, and any other engineering service.

These jobs are all comparatively small in size and scope and are assigned to project engineers who are responsible for the planning, organization, directing, and controlling the technical and economical phases of a project from its inception through the stages of design, detailed engineering, estimating, and construction to the preliminary operations (if required) of the facility. ★ ★ ★

## Recall Retired Scientists

The Advisory Committee on Science Manpower has come up with one solution to the shortage of science and mathematics teachers — employment of retired scientists and engineers. The idea was conceived to meet New York City's shortage of science teachers, but almost any city could find well qualified persons in retirement.

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OTM Corporation, leading the industry since 1919, now provides an all-encompassing guarantee with BLUE RIBBON FLANGES. This exclusive OTM guarantee not only covers replacement of defective flanges—but guarantees against any and all damage resulting from a defective flange.
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# PERSONALS

**Robert L. Kidd** and **Harry D. Hancock** were made directors of Cities Service Company. Kidd is president of Cities Service Oil Company (Delaware), principal oil and natural gas producing subsidiary of the Cities Service system. Hancock is president of Cities Service Gas Company, which handles production and transmission of gas principally in Texas, Missouri, Oklahoma and Kansas. Both were elected to their presidential posts this year.

Hancock received the American Gas Association Distinguished Service Award in 1947 and its Awards of Merit in 1953.

**P. L. Vanlue,** former division controller of the Ohio Oil Company's Houston production division, has been appointed assistant chief auditor in Ohio Oil's general offices, Findlay, Ohio. He is succeeded by **L. F. Willhite,** former assistant division controller. **J. S. Young,** formerly of the company's auditing department, becomes assistant Houston division controller.

Three research scientists have joined the growing staff of Ohio Oil's research center. They are **Dr. Alan S. Horowitz,** research geologist, **Dr. Peter R. Taussig,** research chemist, and **Dr. George B. Miller,** research physicist.

**C. Z. Hardwick,** executive vice president of Ohio Oil was a speaker at the meeting of the Committee on Traffic of the American Association of State Highway Officials, in Atlantic City, New Jersey, November 30. He spoke on the operation of commercial facilities along interstate highway systems and represented the American Petroleum Industry Committee at the association's annual convention.

Appointment of **A. A. Buzzi,** of Shell Oil Company, as vice president of the API's Division of Finance and Accounting was announced. Buzzi, new chairman of the division's general committee, thus becomes the first API vice president for the financial and accounting group, which became a division in 1955.

**A. G. Schei,** treasurer of Shell Oil Company, has been named vice president—finance. He succeeds **J. H. White,** who is retiring in December after 31 years of service.

**C. C. Combs,** vice president and treasurer of Shell Pipe Line Corporation, Houston, Texas, succeeds Schei as treasurer.

**Arthur V. Danner,** vice president and director of Mobil Overseas Oil Company, Inc., has been elected president to succeed **Paul V. Keyser, Jr.**

Keyser, a vice president and director of Socony Mobil, will continue as a member of the Mobil Overseas board.

Also announced was the appointment of **Rawleigh Warner, Jr.,** as manager of the economics department of Socony Mobil Oil Company, Inc., and a member of the company's cooordination committee. He succeeds **Albert J. McIntosh,** who joins the public relations department as a consultant.

**Jack O. McCall** was elected a vice president of the Louisiana Land and Exploration Company and **John G. Phillips** was elected treasurer at a meeting of the board of directors.

**Dr. Charles Van Berg** has been appointed economics advisor to the executive representative of International Petroleum Company, Ltd. in Bogota, Colombia. He received a BS degree in chemical engineering at the University of Texas in 1939. He then obtained his MS and PhD in 1941 and 1943, respectively, from the same university. Dr. Van Berg served with the Humble Oil and Refining Company until his transfer to International Petroleum. His work with Humble Oil included a variety of assignments in the fields of economics and engineering.

**Charles H. Dearborn** has joined the executive office of International Petroleum in Coral Gables, Florida, as management development advisor. He transferred to International from the New York offices of Esso Standard Oil Company where he was assistant coordinator of management development. He received a BA degree from Yale University in 1942.

**Lionel W. Wiedey** will retire soon from International Petroleum after 27 years of experience in almost every phase of the company's operations. Prior to his present executive post at International's offices in Coral Gables he spent more than two decades with the company in Colombia, Ecuador, and Peru. He received a BA degree in geology and petroleum engineering from the University of California, and his masters degree and doctorate from Stanford University, specializing in geology and paleontology.

**William B. Moses, Jr.,** a trustee of Massachusetts Investors Trust of Boston, Massachusetts, and **Dwight L. Simmons,** managing partner of Thompson, Knight, Wright, and Simmons, have been elected to the board of Seaboard Oil Company.

**Robert E. Wilson,** chairman of the board of Standard Oil Company (Indiana), has been appointed to the general advisory committee of the Atomic Energy Commission by President Eisenhower. Wilson's appointment runs through August, 1962.

**George August,** formerly with Arabian American Oil Company, Dhahran, Saudi Arabia, has joined American Independent Oil Company as field manager in the Neutral zone. Prior to going to the Middle East, August was a petroleum engineer with the Long Beach Harbor department.

**S. J. Bell, R. O. Grimes, J. R. Maxwell, Guy Furgiuele,** and **S. L. Newman** have been promoted to associates in the firm of H. E. Bovay, Jr., consulting engineers. Bell is head of design groups; Grimes, project engineer for industrial plants; Maxwell, head of piping design for oil and chemical industries. Furgiuele is air conditioning design director, and Newman, head of civil and structural design.

**Gov. Raymond Gary,** Oklahoma, was named chairman of the Interstate Oil Compact Commission. **Clarence Smith,** Flora, Illinois, was elected first vice chairman and **J. P. Jones,** Bradford, Pennsylvania, named second vice chairman. **Judge Earl Foster,** Oklahoma City, Oklahoma, was re-elected executive secretary.

**Stanley W. G. Lehman** and **James V. Pickering** have been elected directors of Standard-Vacuum Oil Company. Lehman is Stanvac's general representative in Australia. Pickering is general representative in London.

**Robert E. Hornberger,** Dallas, Texas, oil man, has been named a board member of LeCuno Oil Company, Jefferson, Texas, succeeding **Erwin C. Ford,** of Houston, Texas.

**Paul G. Blazer,** chairman of the board of Ashland Oil and Refining Company, has resigned after 33 years as head of the firm and its predecessors. Blazer will remain as chairman of the executive and finance committees of the company. A new board chairman will be elected at the January stockholders meeting. Blazer has indicated he will recommend that **Rexford Blazer,** president of the company, be named chairman, and that **Everett F. Wells,** executive vice president, be named president.

## DEATHS

**Paul E. Williams,** 60, chief oil dispatcher of The Buckeye Pipe Line Company at Lima, Ohio, died suddenly in November of a heart attack. He had over 30 years of service with Buckeye.

**Frank H. Thorne,** chairman of Visco Products Company, Inc., Houston, Texas, and vice chairman of its parent company, National Aluminate Corporation, Chicago, Illinois, died suddenly in October. He had been with National Aluminate since its inception in 1928.

**W. H. McFadden,** Fort Worth, Texas, died November 1, at the age of 87. He was chairman of the board of Southland Royalty Company.

**Granville A. Humason,** Houston, Texas, died at the age of 82. He was widely known as an inventor of oil equipment.

**Neil Thomas Breaux,** inventor of the Wilson Hook-Wall Packers, died in Tomball, Texas, in October, after a very brief illness. Breaux had been with the Wilson Supply Company since December, 1946.

**Bobby Manziel,** independent operator in the East Texas oil fields, died unexpectedly in Tyler, Texas, at the age of 59.

Famed oilman **Harry F. Sinclair,** founder and builder of the Sinclair Oil Corporation, died in Los Angeles, California, at the age of 80. He also played a major role in organizing the Richfield Oil Corporation.

**E. D. Schively,** manager of the Calgary (Alberta, Canada) branch office of Worthington (Canada) 1955 Ltd., died recently after a brief illness. Associated with Worthington Corporation since 1916, Schively had served as district manager of the corporation's Seattle office for 36 years prior to his appointment as the Calgary special representative.

**D. E. Legan** of Houston, Texas, production manager for the southern division of Tidewater Oil Company, died November 25 in Chicago, Illinois. He had suffered a heart attack while attending the convention of the API.

# LAUGH with BARNEY

Confusion is one woman plus one left turn; excitement is two women plus one secret; bedlam is three women plus one bargain; chaos is four women plus one luncheon check.

* * *

A tramp called at a home and asked for a handout.

"And how would you like a nice chop?" asked the kindly housewife.

"That all depends," said the tramp. "Is it pork, lamb, or wood?"

* * *

A drunk lying on the barroom floor began to show signs of life so one joker smeared a little limburger cheese on his upper lip. The drunk rose and walked out the door. In a few minutes he returned. Then he left again only to wobble back in soon after. Shaking his head with disgust he said, "It's no use. The whole world stinks."

* * *

Golf is the game that turned the cows out of the pasture and let the bull in.

* * *

Experience helps you recognize a mistake when you make it twice.

* * *

A new bank clerk, dictating, was in doubt as to the use of a certain phrase, so he said to his stenographer: "Do you retire a loan?"

The wistful-eyed stenographer replied: "No, I sleep with my mother."

* * *

Sam was not as good a hunter as he pictured himself in telling accounts of his adventures, but what he lacked in ability he had in confidence. Duck hunting with some friends early one morning he sighted his game within easy shooting distance. As his double blast broke the stillness of the morning the bird went squawking away.

"Fly on, you fool bird," shouted Sam. "Fly on with your stubborn heart shot out!"

* * *

Ad in paper: "Girl needs a job. Is willing to struggle if given opportunity."

* * *

The chief drawback to New Year's resolutions is that a wife always remembers her husband's.

* * *

"What did you do when her dress started coming off?"

"I helped her out as best I could."

* * *

"Let me show you something new in a snappy sedan," suggested the salesman.

"It won't do you any good," she replied, "and besides, I don't think you could."

* * *

Hostess: "I'm glad you came, Bishop, I was going to send you an invitation, but then I thought, 'Oh, what th' hell.' "

* * *

A chaperone is an elderly woman who accompanies young women to see that they do not indulge in any of the things she would have indulged in if she hadn't been chaperoned when she was a young woman.

A wolf wandered into the tennis match and sat down. "Whose game?" he asked. A shy young thing looked up hopefully, "I am."

* * *

Mrs. Mandy Johnson, surrounded by her brood of 13 pickaninnies, was talking to the spinster settlement worker. "Yes, Ma'am, birth control am all right for you-all but me, I'm married and don't need it."

One duck to another: "Quit trying to walk like a woman wearing slacks."

* * *

A book store returned a copy of the Complete Manual of Sex it had ordered from New York with the notation: "Customer couldn't wait."

* * *

A small town is where everybody knows whose check is good and whose husband isn't.

* * *

Much clothes is what if you go to a burlesque and jump up highly excited there is a nifty tease dancer without.

* * *

One of the best ways to make your old car run better is to learn the price of a '57 model.

This compact and efficient Texsteam Unit supplies high pressure steam almost instantly, *right on the job* . . . for cleaning out parrafin that accumulates in oil well tubing or flow lines. The steam is also used to heat heavy viscous oil so that it can be handled by pumps and for treating tanks of oil that has been emulsified. Power is supplied by a Wisconsin Heavy-Duty Air-Cooled Engine. The complete unit is the product of Texsteam Corporation, Houston, Tex., a division of Vapor Heating Corporation.

Again, Wisconsin always-dependable engine power demonstrates its broad versatility to fit a great variety of oil field power applications. *There is no substitute for the basic heavy-duty stamina and uncompromising quality built into every Wisconsin Engine, from the smallest to the largest.* These engines have been operating in the oil fields since 1937 and many of the original installations are still on the job . . . service-proved performance that speaks for itself. There are no more rugged engines built, horsepower for horsepower, than "WISCONSIN", within a 3 to 36 hp. range.

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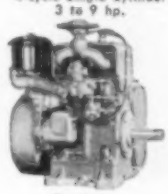
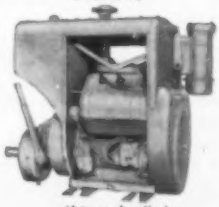
3 to 9 hp.


2-cylinder
7 to 15 hp.


V-type 4-cylinder
15 to 36 hp.

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# BOOKS ★

**Organic Chemistry,** *third edition, by Louis F. and Mary Fieser, published by Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. Pages, 1112. Price, $10.00.*

Since the second edition of the Feisers' book was published in 1949, many new developments have been made in the field of biochemistry, medicine, and in the process industries. The new edition, recently put on the market, is a complete revision to include these advances. The revision develops in orderly sequence the principles and concepts of modern organic chemistry and the applications of the fundamental science to technology and biochemistry and medicine. Thoroughly discussed are new advances in theory. Among them is the molecular orbital theory, now generally recognized as contributing importantly to the understanding of organic phenomena.

Of unusual interest is the inclusion of 454 brief biographical sketches and vital statistics of past and present chemists associated with the many developments cited.

**Scheduling of Petroleum Refinery Operations,** *by Alan S. Manne, published by Harvard University Press, 44 Francis Avenue, Cambridge 38, Massachusetts. Pages, 185. Price, $5.00.*

Believing that the economist and the petroleum industry planner can effectively help each other, the author uses mathematical economics to approach representative problems in oil refinery scheduling. He reviews conventional refinery cost accounting methods, followed by four case studies covering: Allocation of individual crude oils to several refineries at different locations; next, naphtha reforming; then, gasoline blending; and last, scheduling for a small integrated plant that performs cracking, recycling, and blending. Not only a running plan is considered, but also a case involving the construction of new capacity.

As a result of the individual calculations, it is possible to obtain a better understanding of how a refiner might respond to changes in several kinds of variables; the market prices of refined products, the quality specifications of these products, and the amount of capital available for investment in new equipment. A glossary of technical terms, tables, figures, and diagrams complement the text.

**Ira Rinehart's Panhandle Area,** *compiled and edited by Paul J. Kuhn, published by Rinehart Oil News Company, P. O. Box 1208, Dallas, Texas. Pages, 292. Price, $20 to subscribers; $25 to non-subscribers.*

Believed to be the first such reference volume on the Panhandle Area, this book offers a comprehensive presentation of the oil and gas producing aspects of the Panhandle Area. It represents an accumulation of facts and figures from many sources, including small works on local prospects, individual field reports and brief discussions. In addition to the statistical information, interpretive material written by authorities in their spheres of operation is included.

**Techniques of Plant Maintenance and Engineering — 1956,** *proceedings of the Technical Sessions of Seventh National Plant Maintenance and Engineering Show, published by Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, New York. Pages, 248. Price, $10.00.*

Composed of texts of 16 papers, summaries of 15 roundtable discussions, answers to approximately 11,000 specific questions, 110 illustrations, charts and tables, this seventh edition gives special attention to five industries. These include air transport shops, chemical plants, petroleum refineries, paper mills and paper product plants, and textile mills.

Some of the subjects covered are: preventive maintenance, measuring the effectiveness of maintenance, sanitation, equipment replacement policies, 24-hr operation, cost control, inspection procedures, report writing, and relationship between maintenance and purchasing departments.

**Conduction Heat Transfer,** *by P. J. Schneider, published by Addison-Wesley Publishing Company, Inc., Cambridge 42, Massachusetts. Pages, 395. Price, $10.50.*

This textbook considers all four of the available methods for the evaluation of the temperature fields with which the study of conduction heat-transfer is principally concerned. It is designed for use in the first of a three-semester sequence of graduate-level courses on conduction, convection, and radiation, and for use as a supplementary text in the usual undergraduate course covering the three modes of heat transfer in one semester. In addition to the large number of numerical examples presented within the text itself, a sufficient number of problems are included at the end of each chapter.


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"Reversible," "Standard" and "Ideal" types in all sizes. Jaws are drop forged from special steel, are carefully milled, heat treated, hardened and tested. The *Handles* are forged spring steel. The *Chains* are proof-tested to ⅔ catalog strength (1,200 lb. to 400,000 lb.) "Reversible" Jaws give double jaw life. "Standard" Jaws have extra bearing on the handle and forged-in chain guides. The "Ideal" Tongs have V shaped teeth for a sure grip on irregular shapes — fittings, etc.

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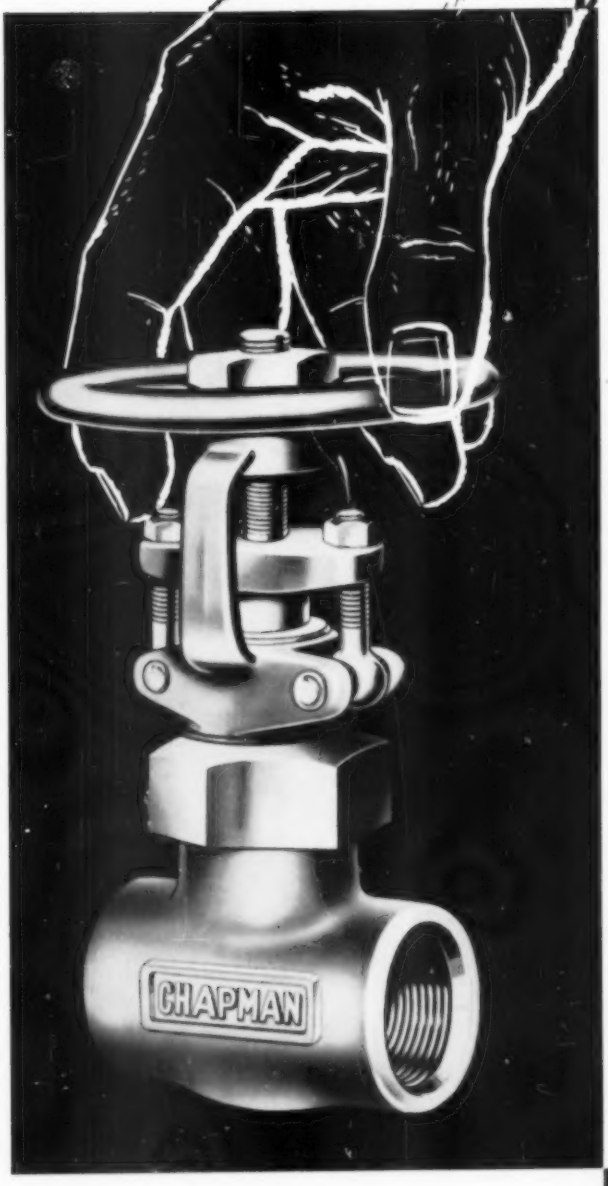


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### *Forged Steel Gate Valves*

This is an open and shut case of top performance and lowest maintenance. To begin with, the wedge faces on Chapman List 960 are *super* hard. In fact, they're hardened to 800 Brinell by Chapman's *exclusive Malcomizing process.* They can't seize. They can't gall. The seat rings are hardened stainless steel. They last longer and, when necessary, they're very easy to replace.

There are no full-pressure repacking difficulties. Bolted follower on the outside screw rising stem design has no threads that are exposed.

Is it any wonder there are more Chapman List 960 valves on more jobs than any other small forged steel gate valve? They stand up perfectly under conditions ranging from 380 psi at 1000°F to 2000 psi at 100°F. You use Chapman List 990 valves for higher pressures. Sizes for List 960 are from ¼″ to 2″. You can have rising stem with yoke or rising stem with inside screw. And the Bonnet joint is either gasketed or ground metal-to-metal, depending upon your needs.

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# LADISH

## SEAMLESS

## *Multiple Outlet*

## FITTINGS

Typical fittings and piping layout of coils in a charge heater.

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### LADISH DESIGNED 90° AND 45° ELBOWS

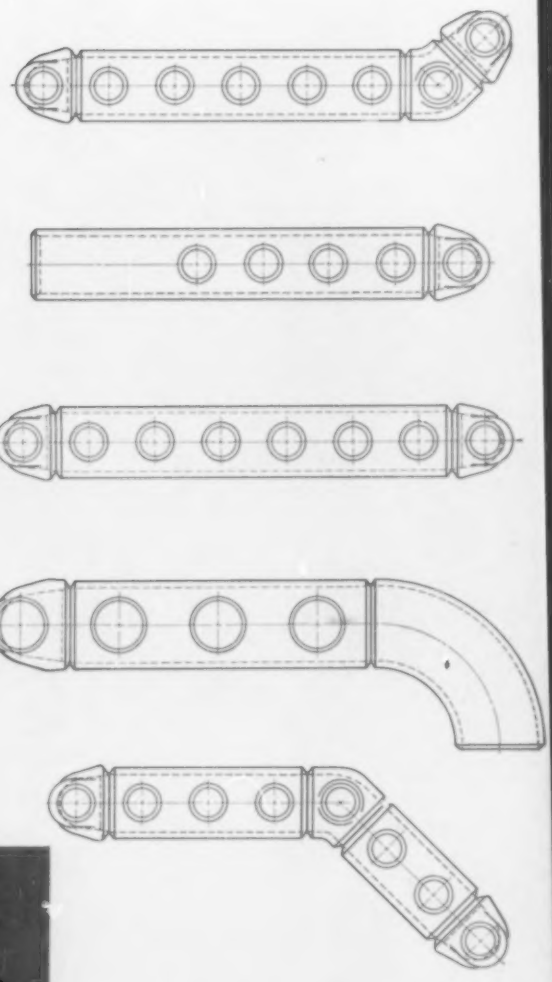
PATENT PENDING

Special die-forged Ladish 90° Reducing Heater Elbow provides a lower cost, easier to make up, final outlet and end closure. Obsoletes expensive, heavy-volume fillet weld required on straight blank-off design. Pressure drop is minimized and flow efficiency improved. Residue collecting pockets and stress risers at critical locations are eliminated. Provides ample clearance between fittings for ease of installation and more expansion allowance.

Ladish forged 45° Side Outlet Elbow effects positive savings in time and cost over the undesirable miter joint otherwise necessary. Eliminates time-consuming angle cutting and welding —then scribing, torching and nozzling-in of outlet directly over miter joint. Only two, easy-to-make circumferential butt welds required . . . deposition of weld metal at this critical juncture is minimized.

# IMPROVE FLOW EFFICIENCY ... SAVE PIPING ERECTION COST IN HEATER INSTALLATIONS

**Illustrated here are typical combinations of Ladish Multiple Outlet Fittings, 90° Reducing Heater Elbows and 45° Side Outlet Elbows produced to meet design requirements for heaters with varying flow cycles.**

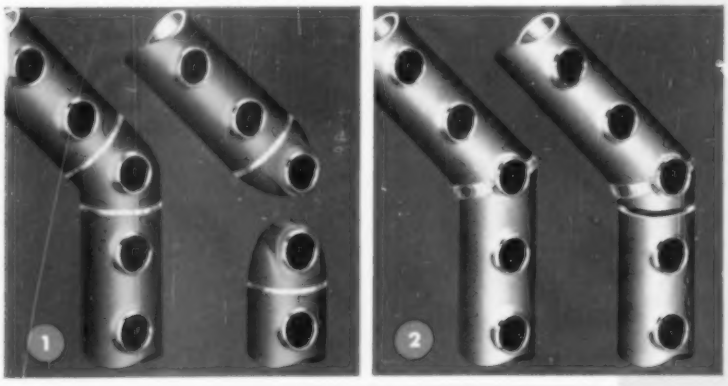


SEAMLESS Multiple Outlet Fittings developed and produced by Ladish . . . offer you significant design advantages and installation and operational economies.

Only simple circumferential welds are required to join the integral outlets to heater tubes. Expensive nozzling-in and reinforcing operations are eliminated.

Ladish 90° Reducing Heater-Elbows and 45° Side Outlet Elbows used in combination with Ladish Seamless Multiple Outlet Fittings further cut installation costs . . . improve both design and flow efficiency.

These fittings are manufactured in a wide range of sizes and material specifications to the same rigid metallurgical and manufacturing standards which distinguish Ladish Controlled Quality Fittings.




1 Ladish streamline design simplifies installation, improves flow efficiency and assures ample expansion allowance between coil sections.

2 Obsolete miter joint construction leaves insufficient space between coil sections, complicates installation, restricts expansion.

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# Standard's educational program helps provide college training for 286 students this year

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THEY CALL THIS THE ATOMIC AGE . . . the era of the "thinking" machine. But above all, this is the age of *human* thought. For today our country needs more and more skilled minds to harness our atoms, advance our culture and guide our government. Standard, too, needs fresh concepts to maintain its position in a highly competitive business. That's why this year Standard's educational program makes available, through colleges, 234 scholarships for undergraduate study, 52 fellowships for graduate work, plus a series of grants to universities.

In these ways, Standard affords young people a better opportunity to contribute to their professions and communities.

***Progress in the West means...***

1956

**trained people will be needed to fill 2½ million new jobs by 1965**

1965

**STANDARD OIL COMPANY OF CALIFORNIA**

# The Trade Parade

### Realignment, Mergers Make News

The Koehring Company and Buffalo-Springfield Roller Company have completed plans to merge. Koehring will be the surviving corporation. Buffalo-Springfield will operate as the Buffalo-Springfield Roller Division of the Koehring Company and will be headed by John F. Harrison, currently vice president and general manager of the merged company. E. S. McCormick has been appointed general sales manager for the division. Merger brings together two of the oldest manufacturers of construction machinery.

Continental Supply Company and Emsco Manufacturing Company, divisions of the Youngstown Sheet and Tube Company, will be consolidated into one division to be known as Continental-Emsco Company. Fred M. Mayer, president of Continental and vice president of Youngstown, wil be president of the new division.

Minneapolis-Honeywell Regulator Company has purchased Davies Laboratories, Inc., manufacturer of specialized high-speed data recording systems. Davies electronic systems use magnetic tape and are designed for high-speed acquisition, reproduction, and analysis of engineering and scientific data. Activities of the Davies Laboratories will be integrated with those of Honeywell's industrial division.

Link-Belt Company announces its acquisition of Detroit Power Screwdriver Company, manufacturer of power-driven screwdrivers and related automated assembly equipment. The Detroit company has 95 employees and will be operated as a subsidiary by its present management, headed by Roy W. Bailey, who, with his associates, founded the enterprise in 1926.

Directors of Consolidated Electrodynamics Corporation have approved purchase of the major assets of R. A. Castell & Company, electronic components manufacturer.

Houston Pipe & Steel, Inc., joins forces with the Flori Pipe Company of St. Louis, Missouri, as a combined operation of their parent company, the Sparton Corporation. The two companies will function with a single administration head with unified sales and quality control staffs located at the St. Louis headquarters.

The boards of directors of Pennsalt Chemicals and Delco Chemicals, Inc., have approved a plan under which Pennsalt will obtain Delco. The acquisition will be accomplished through an exchange of stock.

Norris-Thermador Corporation has acquired North American Instruments, Inc., developer of pressure-measuring systems for petroleum exploration and production. Eugene Bollay, noted meteorologist and engineer, remains as president of the company.

Approval of terms for a merger between Midwestern Instruments, Inc., Tulsa, Oklahoma, and Magnecord, Inc., Chicago, Illinois, is announced. Present plans are for operation of Magnecord as a division of Midwestern Instruments, with an integration of personnel of both organizations. M. E. Morrow will head the company as chairman of the board and chief executive officer.

Paul Hardeman, president of Paul Hardeman, Inc., constructors-engineers, announces the merger of the various subsidiary companies with Paul Hardeman, Inc. All activities of J. B. Gill Co., Wall Cryogenics, Inc., Climate Conditioning Corp., Systems Engineering Co., and Electronetics Corporation have been consolidated and become a part of Paul Hardeman, Inc.

### J&L Occupies New Headquarters

More than 300 employees of the Jones & Laughlin Supply Division have occupied the firm's new $1,700,000 headquarters building in Tulsa, Oklahoma.

The new building is a modernistic brick structure containing more than 100,000 sq ft of floor space. It consists of an air-conditioned office and a large warehouse, with a file storage area in the basement.

### Indiana Plant for Bucyrus-Erie

A new $12,000,000 drill manufacturing plant will be built near Richmond, Indiana, by Bucyrus-Erie Company.

Work on construction of the plant will begin as soon as possible, with completion scheduled for late 1957 or early 1958. The new plant will employ about 1000 people.

Machines to be manufactured at the Richmond plant include water well drills, shallow oil well drills, and blast hole drills.

### Spare Parts Depot Opened In Morgan City by Continental

A spare parts depot, unique in the drilling industry, has been opened by Continental Supply Company in conjunction with its new Morgan City, Louisiana, store.

Purpose of the new installation is to offer drillers throughout the Louisiana Gulf Coast area and all offshore operators expedient service for needed parts for Emsco drilling equipment and Gardner-Denver mud pumps. Both the store and spare parts depot were formally opened October 27.

### Filter Firm Expands

Winslow Engineering and Manufacturing Company, manufacturers of fuel and oil filters and elements, has doubled production facilities at its Murray, Kentucky, plant.

The company has occupied additional buildings for manufacturing and warehouse space and will concentrate element production at Murray.

### Core Lab Begins New Structure

Core Laboratories, Inc., has begun construction on a new Oklahoma City, Oklahoma, building.

An unusual architectural innovation will be the use of oil well cores, taken from wells drilled in Oklahoma, to form one complete wall of the reception room. Cores will be arranged according to geologic age.

Company recently revealed that it had analyzed "The Golden Foot" — the one-millionth core sample to be evaluated since the firm was organized in 1936.

### Brown Fintube Forms Subsidiary

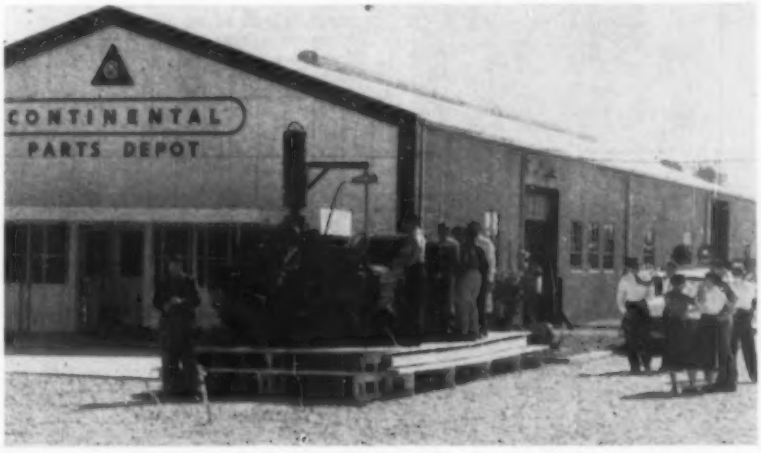
Brown Fintube Co. announces the formation of a subsidiary to be known as The Brown Thermal Development Company.

The new company will develop, design, manufacture, and sell heat transfer equipment for waste heat recovery, recuperation, and air and gas heating by direct fire.

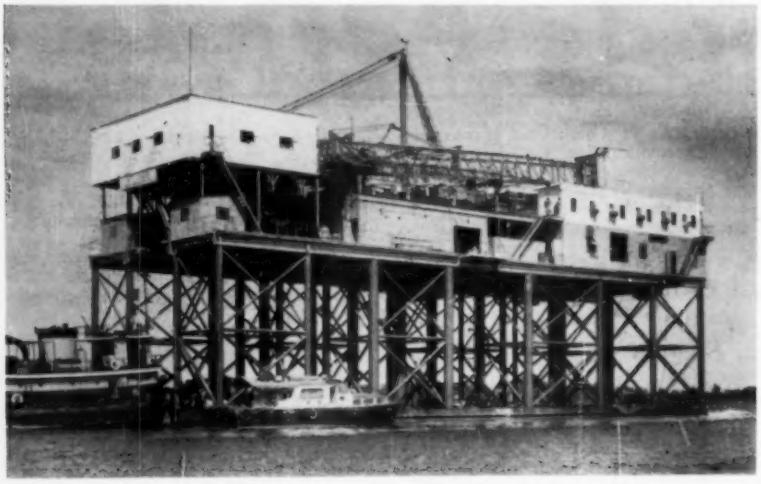
### $10,000,000 Transaction

Texas Instruments Incorporated has entered into an agreement to sell $10,000,000 in notes to The Equitable Life Assurance Society of the United States.

About $4,000,000 of the proceeds will be used to begin construction of new facilities in Dallas, Texas. Remainder of the funds will be used to refinance the company's first mortgage bonds and to increase working capital.




**Formal opening** of Continental Supply Company's new spare parts depot and store in Morgan City, Louisiana, brought many visitors from New Orleans and surrounding areas. In the foreground is the largest mud pump ever built by Gardner-Denver, the model GH-GXH, with a horsepower rating of 1250 at 65 rpm.



**Third in line of giant** deep-water drilling barges, "The St. Louis," has been completed by American Marine Corporation for Ocean Drilling and Exploration Company. A submersible barge measuring 180-ft by 120-ft, the "St. Louis" consists of a two-story unit with drilling and storage deck, air-conditioned living quarters for a 40-man crew, and a helicopter deck. Barge can be submerged to a depth of 30 ft and is capable of drilling to a depth of 18,000 ft.

### Kimray Doubles Facilities

Kimray, Inc., Oklahoma City, Oklahoma, manufacturer of oil field controls, valves, and specialties, has completed an expansion program that more than doubles its machining and assembly facilities.

2
GREAT NAMES ARE JOINED!
SEE PAGES A-18-A-19

### Meter Firm Dedicates New Plants

Two new plants were opened in December by American Meter Company. Located in Fullerton, California, and Garland, Texas, new establishments are part of expansion program to be centered in leading oil and gas producing areas.

A complete line of measuring and control equipment for the petroleum and chemicals industries will be manufactured or assembled by the new plants.

In addition to manufacturing facilities, each new plant is equipped with repair and service facilities and warehousing for complete servicing of products in the field.

George W. Stevenson is manager of West Coast operations, Fullerton, and Carl M. Brehm factory superintendent.

### Huge Stress-Relieving Oven

Installation of a $160,000 stress-relieving furnace has been completed at the Shreveport, Louisiana, plant of The J. B. Beaird Company, Inc.

The huge furnace accommodates a vessel 12 ft in diameter and 78 ft long in one heat. This gas-fired furnace will normally operate at 1100 to 1200 F, with a maximum range to 1400 F.

Vessels will be introduced into the furnace by a furnace car made up of eight four-wheeled sections and chain-driven by a 10-hp electric motor located outside the oven area.

### Rubber Plant Addition Under Way

Construction is under way on a $3,000,000 addition to American Synthetic Rubber Company's Louisville, Kentucky, manufacturing plant.

This addition will increase existing facilities at the Louisville plant by 50 per cent. Completion is scheduled for January, 1957.

Three major structures constitute the expansion project: a 10,500-sq ft reactor building, a three-story recovery building totaling 8000 sq ft, and a 12,900-sq ft finishing building.

### Firm Seeks Research Contracts

The Fluor Corporation, Ltd., announces that its research division will actively seek industrial contract research in the petroleum, chemical, and petrochemical industries for the first time in the firm's 66-year history.

Fluor Research's position as a division of an engineering and construction organization affords opportunity for evaluating a project and carrying ideas through to realities. Company's engineering and design specialists can also assist on individual research projects.

### Cummins Plans Scotland Plant

A plant for the manufacture of Cummins diesel engines at Shotts, Lanarkshire, Scotland, will be established by Cummins Engine Company, Inc. New company will be a wholly owned subsidiary to be known as Cummins Engine Company, Limited.

A modern, one-story factory building has been leased in Shotts, 18 miles southeast of Glasgow. Cummins officials report the plan is to begin production in the new plant in 1957 and to be in full operation in two years.

## PEOPLE

▸ **R. E. Reimer,** vice president, secretary and treasurer of Dresser Industries, Inc., has been elected to the board of directors of the company.

▸ **Larry Harper,** vice president of Franklin Supply Company, has been elected executive vice president of the company. In his new position, Harper will supervise the operation of Franklin's 22 stores and offices in the U. S. and Canada.

R. B. Manning

▸ **Robert B. Manning,** formerly vice president and treasurer of Sperry Western, Inc., has been elected to the presidency of the firm.

Since 1954, Manning has been assistant to the president and products manager of Sperry Products, Inc., a position he will continue to hold. **Clinton R. Hilliker** has been named operating manager and a director of the company.

▸ **Leo B. Grant,** manager of the New York office of The Dow Chemical Company, has been named to the newly created position of sales manager of the chemicals department, with headquarters in Midland, Texas. **James Day,** supervisor of chemical sales in the New York office, will succeed Grant.

▸ **J. L. Manthe** has been elected chairman of the board of The Youngstown Sheet and Tube Company.

**A. S. Glossbrenner,** former vice president of operations, has been elected president, succeeding Manthe. **Walter E. Watson,** former first vice president, has been elected vice chairman of the board.

Other elections are **William H. Yeckley,** former manager of steel operations, to vice president of operations and **Frederick M. Mayer,** president of Continental Supply Company, to vice president.



Trade Parade

*exhaustive tests prove:*

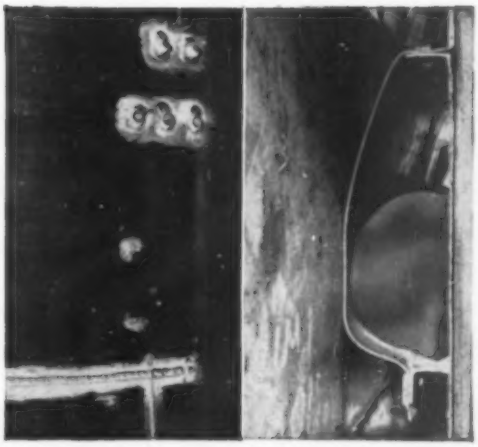
# 36 YEARS FROM TODAY

# TUBESEALS* NOW IN FLOATING ROOF TANKS WILL OPERATE AS EFFICIENTLY AS THEY DO TODAY!

**WE DOUBT this can be claimed for any other floating roof seal!**

To determine the efficient life-expectancy of the Hammond Tubeseal in service, tests were made under the worst possible conditions to which a floating roof seal can be subjected. The Tubeseal was moved across very rough rivet heads, erection burrs and abrasive weld surfaces, for a total travel of 70,000 feet. This is equivalent to a normal wear of *more than 36 years in actual service.* Moreover, as the tests were run dry, there was the added disadvantage of the absence of lubricating effect normally created by wetted surfaces. Upon completion of these rigorous tests, the scuff band had only worn through the ribs and had barely penetrated through the material, leaving two-thirds of the stock intact; proof that the Tubeseal is unimpaired after traveling 70,000 feet.

The 36 year life-expectancy of a Hammond Tubeseal assumes no mechanical accident and is arrived at in the following manner: Each year a floating roof, in normal service, makes about 48 trips to and from top and bottom of tank. The roof of a 40 foot tank, therefore, will travel 1920 feet per year. Assuming 1920 feet of travel per year (based upon full depth of travel) and applying our accelerated wear test, the Tubeseal will be serviceable for at least 36 years 5½ months.



**THE TUBESEAL TEST:**

| | |
|---|---|
| total travel | 70,000 feet |
| travel over vertical weld | 46,400 feet (on same line) |
| Horizontal welded seam crossed | 21,200 times |
| Flat head rivets crossed | 63,600 times |

CONDITION OF TUBESEAL AFTER TEST: Scuff band had worn through ribs and had barely penetrated into the main material, leaving ⅔ of stock intact.

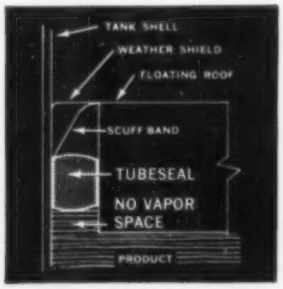
Tests were conducted dry with no aid of lubricant normally resulting from stored product.

*Photos show projections used for test. Included are 16"of ⅜" horizontal weld—24" of sharp, irregular vertical weld—2 erection burrs—3 ¾" flat head rivets and 2 ¾" cone head rivets.*

**THE HAMMOND TUBESEAL**
***is the most efficient and positive seal known.***

*it features:*

*no moving parts*
*no mechanical maintenance*
*climate proof*
*non-corrodible*
*can operate to bottom of tank or above the top*
*no vapor space below the seal*
*entire circumference has tight seal under pressure at all times*
*longer working life expectancy*




**NO ROOM FOR VAPORS**
**NO EVAPORATION**
**NO CORROSION**

**patented*

***Write for bulletin TS***

HAMMOND TUBESEAL — THE MOST EFFICIENT AND POSITIVE SEAL KNOWN

**HAMMOND IRON WORKS**

WARREN and BRISTOL, PA. • PROVO, UTAH • CASPER, WYO. • BIRMINGHAM, ALA.

*Sales Offices:*

BOSTON 10, MASS. • NEW YORK 20, N. Y. • CINCINNATI 2, OHIO • CHICAGO 3, ILL. • WARREN, PA. BRISTOL, PA. • ARLINGTON, VA. • GREENVILLE, S. C. • BIRMINGHAM, ALA. • SAGINAW, MICH. SAPULPA, OKLA. • PROVO, UTAH • CASPER, WYO. • LOS ANGELES 57, CALIF. • HAVANA • MEXICO CITY "TIPSA," BUENOS AIRES • CAIRO, EGYPT • PORT-AU-PRINCE, HAITI • LIMA, PERU

*Licensees:* CALIFORNIA, CANADA, ENGLAND, BELGIUM, GERMANY, ITALY, FRANCE, JAPAN



## *Trade Parade*

## Trade Parade

▸ **E. W. Masters** has been appointed a director and consultant for Great Lakes Oil & Chemical Company. Masters will be actively engaged in the operations of the Great Lakes Company, and will be located at the company's offices in Los Angeles, California.

▸ **Joseph P. Jatis** has been named manager of two-way radio service training of the communications and electronics division of Motorola, Inc.

**Robert L. Borchardt** has been made manager of the technical information center, succeeding **Harold A. Jones,** who was promoted to his present position as director of sales earlier this year.

**Frederick W. Alexander** has been promoted from technical editor to advertising manager.

▸ **Harry G. Knechtel** has been appointed manager of sales operations of the Hewitt Rubber Division, Hewitt-Robins, Inc. He succeeds **Charles W. Mackett,** who will retire this year.

▸ **Walter L. Brough,** who has been serving as assistant to the president, has been promoted to executive vice president of Hercules Motors Corporation.

▸ **A. W. Pratt** has relinquished his responsibilities as chief engineer, process division of Stone & Webster Engineering Corporation to become engineering manager of E. B. Badger & Sons Limited, an affiliate of the corporation in London, England. Pratt's former responsibilities in the Boston, Massachusetts, office will be assumed by **T. E. Casselman** as acting chief chemical engineer.

ARCCO
ARCCO-ANUBIS
GAS GRAVITOMETERS
DIRECT WEIGHING
DIRECT READING
—No Computations
Once calibrated and properly installed this Gravitometer requires no further attention. Hundreds are in daily use in pipelines and refineries of major companies. There are no electric motors, pressure regulating valves or other complex arrangements; is practically frictionless, thus minute changes in specific gravity are recorded as they occur. Years of use have proven that Arcco-Anubis Gas Gravitometers remain accurate and highly responsive even under severe conditions of service. Also, available in double column "dry air" type which automatically corrects for humidity content of the air. Send for bulletin No. 101.
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RECORDING CHART CO.
3113 E 11th St • Los Angeles 23, Calif.
Available for Early Delivery
SEND FOR BULLETIN 101-R3


▸ **Walter F. Munford,** president, American Steel & Wire Division of United States Steel Corporation, has been advanced to

W. F. Munford

V. H. Leichliter

an assistant executive vice president of the parent corporation. At the same time, **Van H. Leichliter,** vice president in charge of operations, American Steel & Wire, succeeds Munford as president of the division.

▸ **Howard A. Reid** has been appointed executive assistant to the vice president in charge of sales for Walworth Company. Reid will coordinate advertising, market research, sales training, sales promotion, and public relations for Walworth.

▸ **Thomas W. Johnson** has been elected vice president of The New York Air Brake Company.

T. W. Johnson

J. W. McEvoy

▸ **John W. McEvoy** has been appointed vice president and general manager of the Lebus Manufacturing Company, a new wholly owned subsidiary of American Hoist and Derrick Company.

▸ **Warner Lewis Jr.** has been appointed midwest zone manager for the Warner Lewis Company, a division of Fram Corporation. Prior to his new appointment, Lewis served as assistant sales manager in charge of sales in the western United States.

Warner Lewis, Jr.

W. E. Powell

▸ **Wilbur E. Powell** has been appointed sales manager for Birdwell Surveys, Bradford, Pennsylvania. Formerly sales manager in Illinois for Larkin of Butler, he has returned to Birdwell after an absence of six years. He will also be in charge of advertising for Birdwell.

**Calvin McCormick** has been named director of sales and assistant general manager of Walter Kidde Constructors, Inc., southwest division, and of Walter Kidde Engineers Southwest, Inc.

Calvin McCormick

W. R. Barton

**W. R. "Bill" Barton,** former treating engineer for BrakeSol, Inc., at Casper, Wyoming, has been promoted to sales promotion manager, Oklahoma City, Oklahoma. Replacing Barton in Casper will be **W. J. "Bill" Boulden.**

**Francis Marion Banks,** president and general manager of the Southern California Gas Company, has been elected to the board of directors of Servomechanisms, Inc. **Thomas R. Cataldo** has been appointed sales manager of the Mechatrol Division of Servomechanisms.

The advertising and public relations department of Servomechanisms has moved to western division headquarters in Hawthorne, California.

**Dr. Robert E. Buchele** has been named staff assistant to the western division manager, Hawthorne.

**Herbert L. Willke** has been named assistant director — engineering and **Peter Tauson** assistant director — research by the National Supply Company. The men will serve in Pittsburgh, Pennsylvania.

**A. R. Reinarz** has been promoted to chief engineer and **Richard N. Cordrey** to assistant chief engineer at the Toledo, Ohio, plant of the company.

**Robert J. MacLean Jr.,** has been made assistant sales manager, merchandising

H. L. Willke

Peter Tauson

products, for National Supply, with headquarters in Pittsburgh. **James C. Woods** has been appointed manager of a newly opened branch office for National Supply's export division at Houston, Texas. He will be assisted by **B. K. Barstow. Donald T. Denney** is now division sales manager for the eastern division of the company. He succeeds Woods.

**C. J. Baeten,** Wichita, Kansas, and **G. H. Osborn,** Edmonton, Alberta, Canada, have been named sales representatives for Win-Well Manufacturing Company.


JOHNSON *RIGHT-ANGLE* GEAR DRIVES

Selected for Dependable Performance and Low Cost of Operation & Maintenance

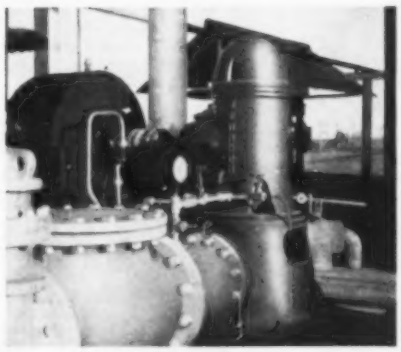

Photo Shows: Cooling Tower Application At Levelland, Texas

Wide Application In Oil and Gas Industries

The Johnson Right Angle Gear Drive serves refineries and process industries for Cooling Tower installations. JOHNSON Right Angle Gear Drives are sold through Pump, Turbine and Engine Manufacturers and their authorized representatives. Catalog and Engineering Data on request.

FEATURES PIONEERED BY JOHNSON

★ SPIRAL OIL PUMP
★ DUPLEX THRUST BEARING
★ STRAIN RELIEVED ALLOY IRON
★ COUNTER FLOW OIL COOLER
★ OIL SIGHT WINDOW
★ Complete INSTRUCTION MANUAL

JOHNSON GEAR & MANUFACTURING CO. 8th & Parker Streets BERKELEY 10, CALIF.



AS AN ENGINEER

How's your GRASP?

You work with complex ideas. Do you "see" them quickly enough? You can with the new NORMA Pen and 3-Pencil Combination. It writes in 3 colors of pencil and as a pen . . . gives greater visual clarity . . . saves time! Guaranteed for mechanical perfection by NORMA, makers of quality Multikolor Pencils for over 25 years.

The New norma pen and 3-pencil COMBINATION

#604 — in Chrome $5.95

INTRODUCTORY Offer: Extra ink refill FREE!

If not available at your dealer, order direct from:

NORMA PENCIL CORP., Norma Bldg., Dept. PE 137 West 14th St., New York 11, N. Y.

Please send _____ #604 NORMA PEN and 3-PENCIL COMBINATIONS at $5.95 each. I desire them engraved at 50c each.

NAMES FOR ENGRAVING: (please print)

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☐ Send information on other models of NORMA —from $5.00 up

I enclose Check ☐ Money Order ☐ Amt. $_____ (If in N.Y.C. add 3% tax)

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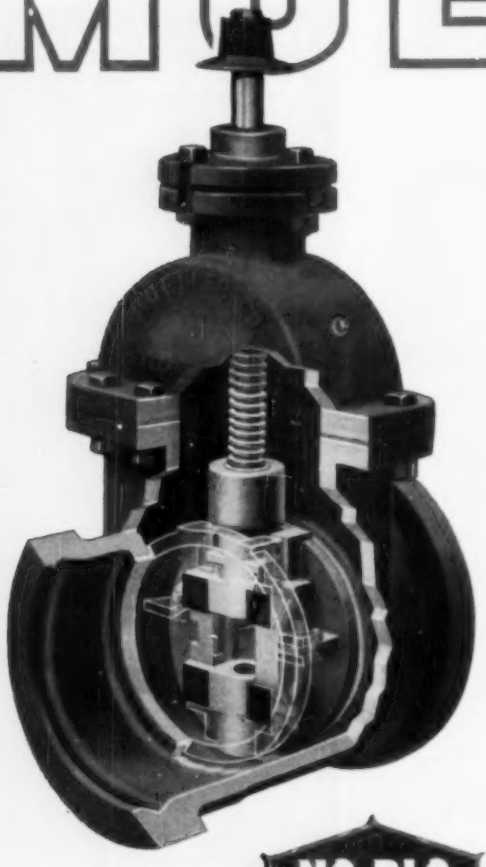
# MUELLER®



## GATE VALVES

### WITH PERIMETER PRESSURE DISC SEATING.

Exclusive "four-point contact" disc wedging mechanism of Mueller Gate Valves assures you of positive shut-offs. Closing pressure is exerted evenly around the perimeter of each disc to prevent disc deflection and subsequent leakage.

Discs are lowered completely before axial movement starts. Discs seat flat against the body rings without sliding – providing long seat and disc life.

### NON-RISING STEM.

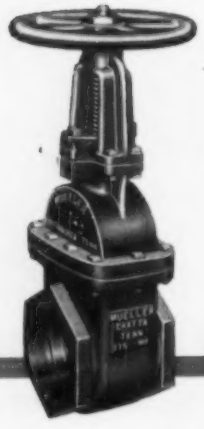
"O" rings around stem seal tighter as pressure increases. Reservoir between "O" rings is filled with lifetime lubricant – assures you of easy turning at all times.

### OUTSIDE SCREW AND YOKE.

Packing gland may be adjusted, or new packing installed while valve is in the line under pressure in the fully open position.

NO-BLO®

All Mueller Gate Valves are iron body, bronze-mounted and are available with flanged, screwed, hub or mechanical joint ends. Sizes range from 2" through 48". Working pressures to 175 p.s.i., W.O.G.



**MUELLER CO.** **DECATUR, ILL.**

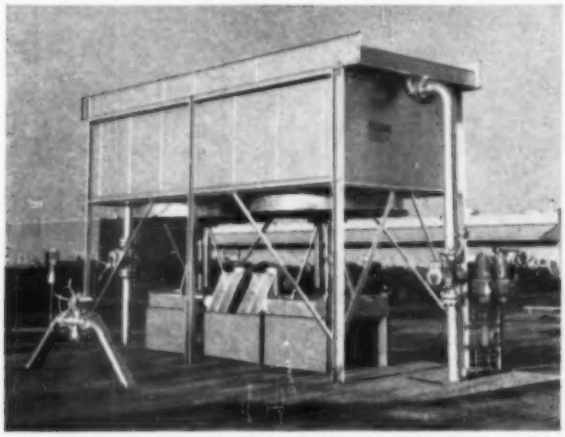
Factories at: Decatur, Chattanooga, Los Angeles; In Canada: Mueller, Limited, Sarnia, Ontario

*Since 1857*

*Contact your Mueller Representative or write direct for complete information.*

# Young Engineering Talent

## Designs Efficient Gas Cooler For Pipeline Compressor Station



Young HC-1807 gas cooler designed for moderate operating pressure (500 psig operating pressure, 800 psig design pressure). Its V-belt drive turns two 81" fans.

## "HC" UNITS by Young

### cool gas to proper temperature for pumping

At the Oklahoma City compressor station of the Oklahoma Natural Gas Company two "HC"—horizontal core—units made by Young Radiator Company are used to cool gas being fed through the pipeline. One of the units is shown above. A third Young-built "HC" cools engine jacket water, compressor jacket water, and lube oil cooling water for four 440 HP engine-compressors. The latter unit utilizes a single stream of water for all three services.

### "HC" Heat Exchangers made by Young Lead in Efficiency, Economy and Versatility

These horizontal core units combine the *efficiency* of vertical air discharge, the *economy* of compact design, and the *versatility* of multiple unit combinations. They are especially practical for cooling water, oil and gases and for condensing steam and vapor.

Write Dept. A-217 for FREE Catalog.

## Put Young Talent to work for you . . .

Solving heat transfer problems is what we do best because it is our very reason for being. You, too, can harness the power of Young engineering talent. Write, wire or call without obligation.

HC is a registered trademark.

**Young RADIATOR COMPANY**
RACINE, WISCONSIN

*Creative* HEAT TRANSFER ENGINEERS FOR INDUSTRY

Heat Transfer Products for Automotive, Aviation and Industrial Applications. Heating, Cooling, Air Conditioning Products for Home and Industry.

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Mattoon, Illinois

*"Here comes your QD Sheave—the original two-piece design."*

## QD = quick delivery

Sure as 2 + 2 = 4 . . . you get quick delivery when you ask for a Worthington QD sheave or Worthington-Goodyear V-belt.

Reason is that your Worthington distributor carries most sizes of Quick Detachable sheaves in stock, can get others from nearby warehouses. We call the original two-piece sheave "Quick Detachable" because it's so easy to get on and off the shaft. But it holds tight on the shaft once it's there.

Call your Worthington man or supply store now. You'll see what we mean. MV.6.1

**WORTHINGTON**

**Buy These Worthington Standard Products From Your Local Distributor**

**COMPRESSORS • PUMPS • MULTI-V-DRIVES • VARIABLE SPEED DRIVES**

# RADIOACTIVE

## Tracers and Sources

*for the*

## OIL INDUSTRY

***May be used for . . .***

- LOGGING
- RADIOGRAPHY
- LEVEL GAGING
- DENSITY GAGING
- CATALYST ATTRITION
- MIXING EFFICIENCY
- REACTION CATALYST
- PRODUCT RESEARCH
- FLOW TRACING and MEASUREMENT

Our facilities and personnel are at your disposal for assistance on these and other radioisotope uses in the petroleum industry.

*Write Today for Complete Brochure to Dept. PE*

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**ISOTOPES SPEC. CO., INC.**

A Subsidiary of Nuclear Corporation of America, Inc.

703 S. Main St., Burbank, Calif.

# GIVE YOURSELF A BREAK!

with **BrakeSol**

**HOLDS PARAFFIN IN SUSPENSION from FORMATION to REFINERY**

**Now is the time to give yourself a break with BrakeSol and clean the paraffin from your production system. Then keep it clean by setting up a program of constant treating.**

**FORMATION.** Get more production by cleaning up the formation with BrakeSol. Use with frac jobs to get more effective results.

**HEATER-TREATER.** BrakeSol will allow the use of less heat, thereby increasing the gravity of your oil.

**TANKS.** Clean up that tank bottom by treating it back into the oil where it can be sold. Equally effective on the largest pipeline tank and the smallest stock tank.

CARMI, ILLINOIS 4-2905
CASPER, WYOMING 2-3453
GREAT BEND, KANSAS 4285
FT. MORGAN, COLO. UNderhill 7-6389
HOUSTON, TEXAS HOmestead 5-6648
LOVINGTON, NEW MEXICO 6-5954
NEW IBERIA, LOUISIANA EMerson 9-2498
ODESSA, TEXAS FE 7-7192
ARDMORE, OKLA. 6489
OKLAHOMA CITY, OKLA. VI 3-6629 WH 9-5561

**CONTACT YOUR NEAREST BRAKESOL TREATING ENGINEER**

**Your BrakeSol Treating Engineer can show you the most effective methods of application and how to accomplish all of the above in one simple operation. Make money and save trouble this winter by the use of BrakeSol.**

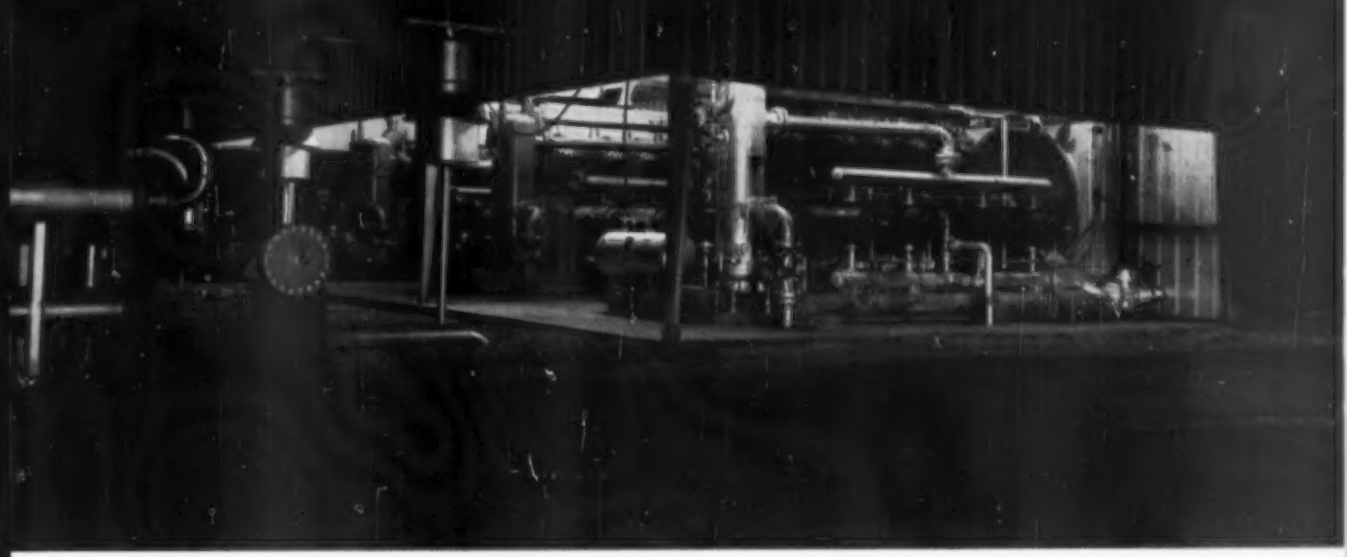
- **Export Distributor: The National Supply Co.** Export Division 600 Fifth Avenue New York, New York, U.S.A.

**BRAKESOL, Inc.**

P.O. Box 9506 Okla. City, Okla.

# BEAIRD-INGERSOLL-RAND
## *Packaged Compressor Plant*

Lowest Cost Per Horsepower Installed



NATURAL GAS AND OIL COMPANY'S SLIGO FIELD STATION—equipped with three Beaird-Ingersoll-Rand 10SVG 550 h.p. packaged compressors, Young Radiators with lubricating oil coolers, gas coolers and all necessary controls. Other sizes 110 to 660 h.p.

Natural Gas and Oil Company has twice expanded this compressor station in Sligo Field, Louisiana. Originally it was equipped with a single Beaird-Ingersoll-Rand 10SVG 550 h.p. compressor. In designing the station the engineers provided the space and piping to accommodate units that would be added on as needed. Now picking up gas from 24 low pressure wells at 650 psig. the station is boosting from 40 mmcfd to 50 mmcfd to transmission lines at 1050 psig. The last unit installed in August of this year will enable the station to follow the pressure on down to 200 psig. without change from single-stage operation. At this point in production the units will be changed in the field to two-stage operation. And finally as the field nears depletion, one or two of the compressor plants may be transferred as a complete package to another site, leaving the remaining plant to complete production.

*Let us show you the versatility possible with packaged compressors designed for your production needs.*

*Versatile Packaged Compressors–*

**SOLUTION FOR EXPANDING STATION**

**BEAIRD** MACHINING MANUFACTURING STEEL WAREHOUSE

**THE J. B. BEAIRD COMPANY, INC.**

PACKAGED COMPRESSOR PLANTS

CAST STEEL FITTINGS

PRESSURE BULK STORAGE

ANHYDROUS AMMONIA EQUIPMENT

LP-GAS SYSTEMS

SHREVEPORT, LOUISIANA • Sales Offices: *Dallas, Houston, Corpus Christi and Midland, Texas* • *New Orleans, Louisiana* • *Tulsa, Oklahoma* • *Denver, Colorado* • *Los Angeles, California, and Cie. Ingersoll-Rand, Paris, France*

# CONTROLLED QUALITY

## COMPLETE STRESS RELIEVING ON BEAIRD LPG-NH3 STORAGE TANKS

Engineers will tell you that stress relieving produces safer, more dependable storage vessels by eliminating internal stresses set up during forming, rolling and welding of tank sections. This important safety feature is available from Beaird, Shreveport, where one of the South's largest stress relieving furnaces is in operation.

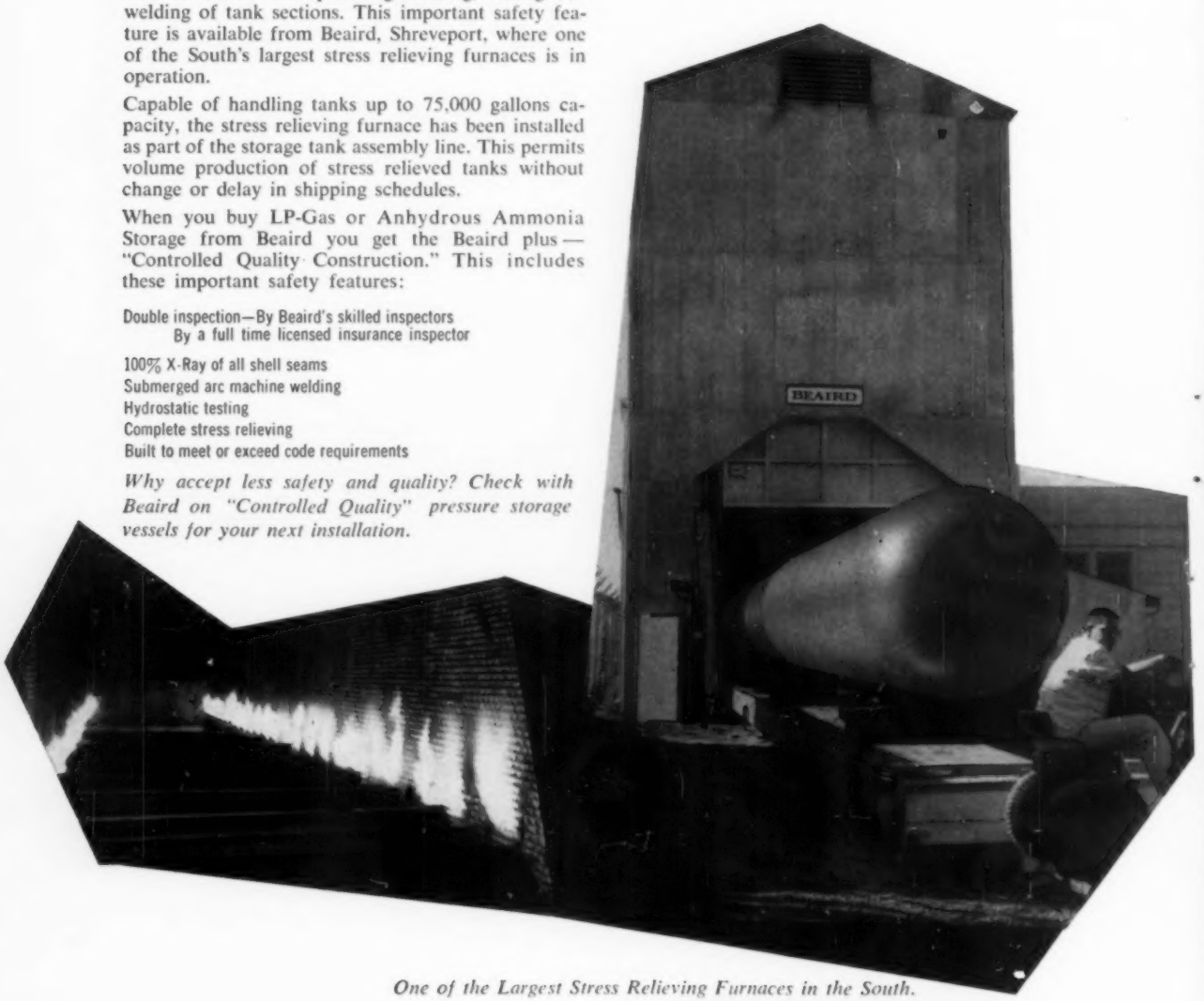
Capable of handling tanks up to 75,000 gallons capacity, the stress relieving furnace has been installed as part of the storage tank assembly line. This permits volume production of stress relieved tanks without change or delay in shipping schedules.

When you buy LP-Gas or Anhydrous Ammonia Storage from Beaird you get the Beaird plus — "Controlled Quality Construction." This includes these important safety features:

Double inspection—By Beaird's skilled inspectors
By a full time licensed insurance inspector

100% X-Ray of all shell seams
Submerged arc machine welding
Hydrostatic testing
Complete stress relieving
Built to meet or exceed code requirements

*Why accept less safety and quality? Check with Beaird on "Controlled Quality" pressure storage vessels for your next installation.*




*One of the Largest Stress Relieving Furnaces in the South.*

**BEAIRD**

**THE J. B. BEAIRD COMPANY, INC.**

LPGA

LP-Gas | Anhydrous Ammonia | Pressure Bulk Storage | Transports | Filling Station

Shreveport, Louisiana
Clinton, Iowa
Stockton, California

*The World's largest manufacturer of LP-Gas systems.*

2

GREAT NAMES ARE JOINED!

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DURA PLASTIC *Teflon* packing for chemicals

DURA PLASTIC STYLE 666 F Die-Molded Rings

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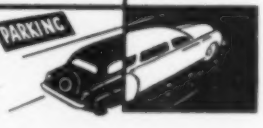

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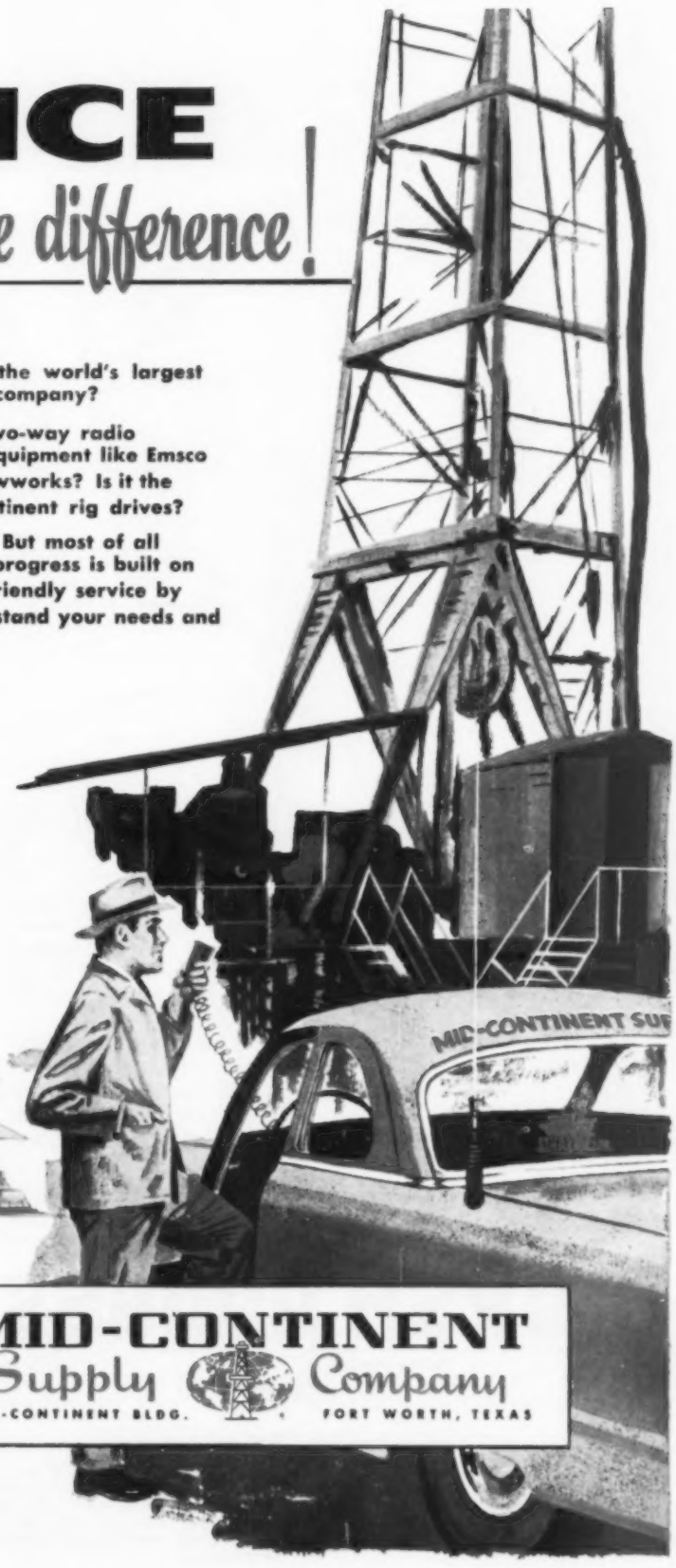


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## Six choices of corrosion resistant tubes and sockets

**4130 alloy steel** tube with alloy steel tip and socket.

**403 stainless steel** tube with alloy steel tip and socket.

**403 stainless steel** tube with 416 stainless tip and socket.

**316 stainless steel** tube with alloy steel tip and socket.

**316 stainless steel** tube with 303 stainless tip and socket.

**Monel** tube with alloy steel tip and socket.

Tubes and sockets listed above are available in Type 100 Mastergauges which are designed for extreme service and pressures. Type 101 Mastergauges, for medium and high pressures, are available with:

**4130 alloy steel** tube, with alloy steel tip and socket.

**403 stainless steel** tube, with 416 stainless steel tip and socket.

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# STAINLESS...from socket to tip

Another Marsh development! The superlative Mastergauge is now available with stainless and alloy steel bourdon tubes. Try to find a corrosive service that isn't covered by range of materials listed above.

Tube, socket and tip—every part subjected to a corrosive medium—are fused into one piece by the "Connoweld" process . . . the exclusive process that distinguishes the Marsh Mastergauge from all other gauges.

Whether you need a gauge for corrosive service or any other critical application, Mastergauge is the one correct answer. It gives you the leak-proof Connoweld construction, the stronger, more durable copper-clad Marshalloy case, the precision Mastergauge movement, the "Recalibrator" to preserve its unmatched accuracy. Ask for data covering your specific gauge needs.

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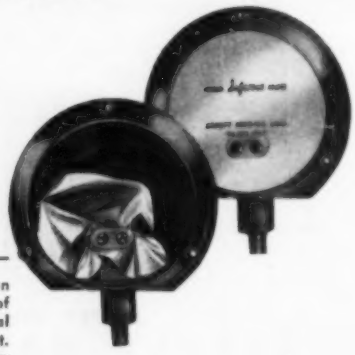

**Explosive force merely opens safety back—**

Photo shows result of laboratory test in which gun cartridge was discharged in rear compartment of Safecase. Thin, tough back yields to abnormal pressure, but cannot be dislodged by blowout. Front of gauge remains intact, protected by heavy metal barrier.

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## petrochem-isoflow furnaces

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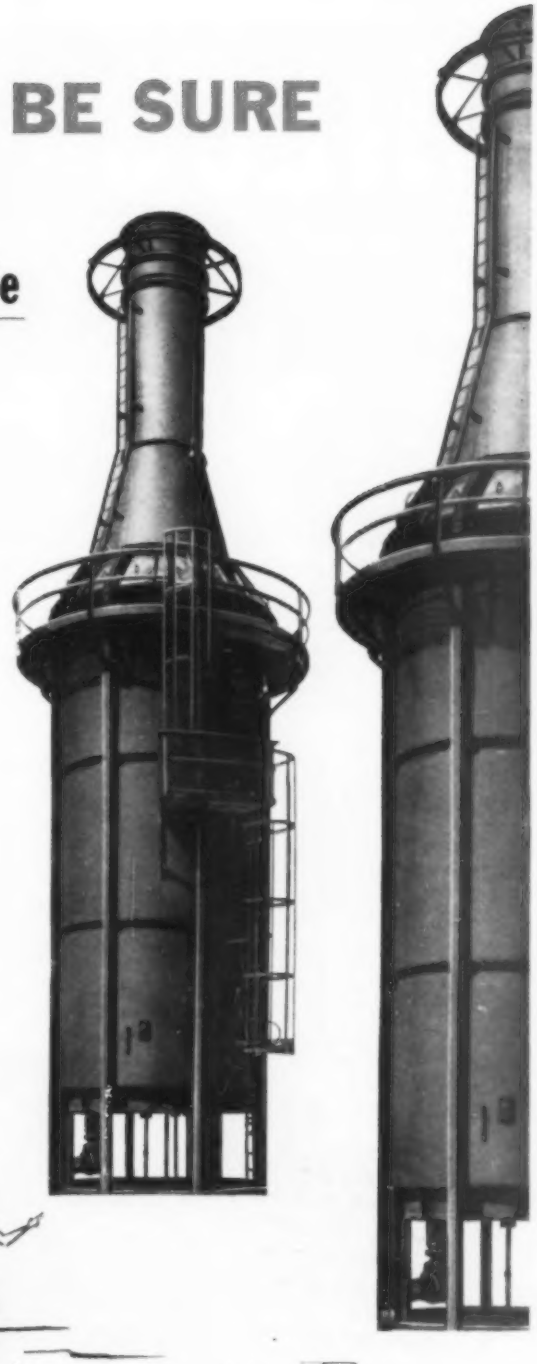

Whenever *all* the specifications and *all* the operating requirements are applied to direct-fired furnace design, you can be sure PETROCHEM-ISOFLOW FURNACES will be found most economically desirable, by any comparison.

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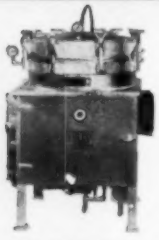
## *Saves* Your Oil, Money and Machinery



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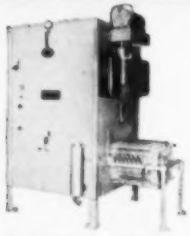
For continuous oil purification in range of 2-100 gph. Removes all solids, acids and volatile contaminants.



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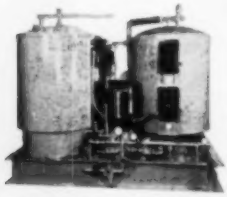

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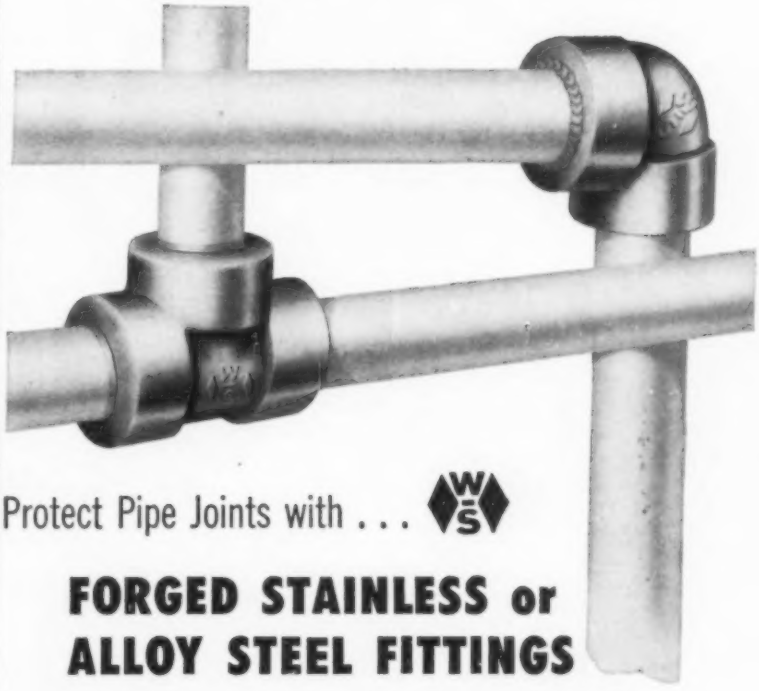

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**IN CORROSIVE SERVICE** your pipe joints take a beating—fluid velocity and turbulence accelerate corrosion wherever there is a change in direction of flow.

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W-S Forged Stainless and Alloy Steel Fittings can be obtained in Screw-End Type for 2,000 lb., 3,000 lb., and 6,000 lb. WOG service; Socket-Welding Type for Schedules 40, 80, 160 and Double-Extra Heavy Pipe. Send today for bulletin S-1-55.

Write to W-S Fittings Division, H. K. Porter Company, Inc., P.O. Box 95, Roselle, N. J.

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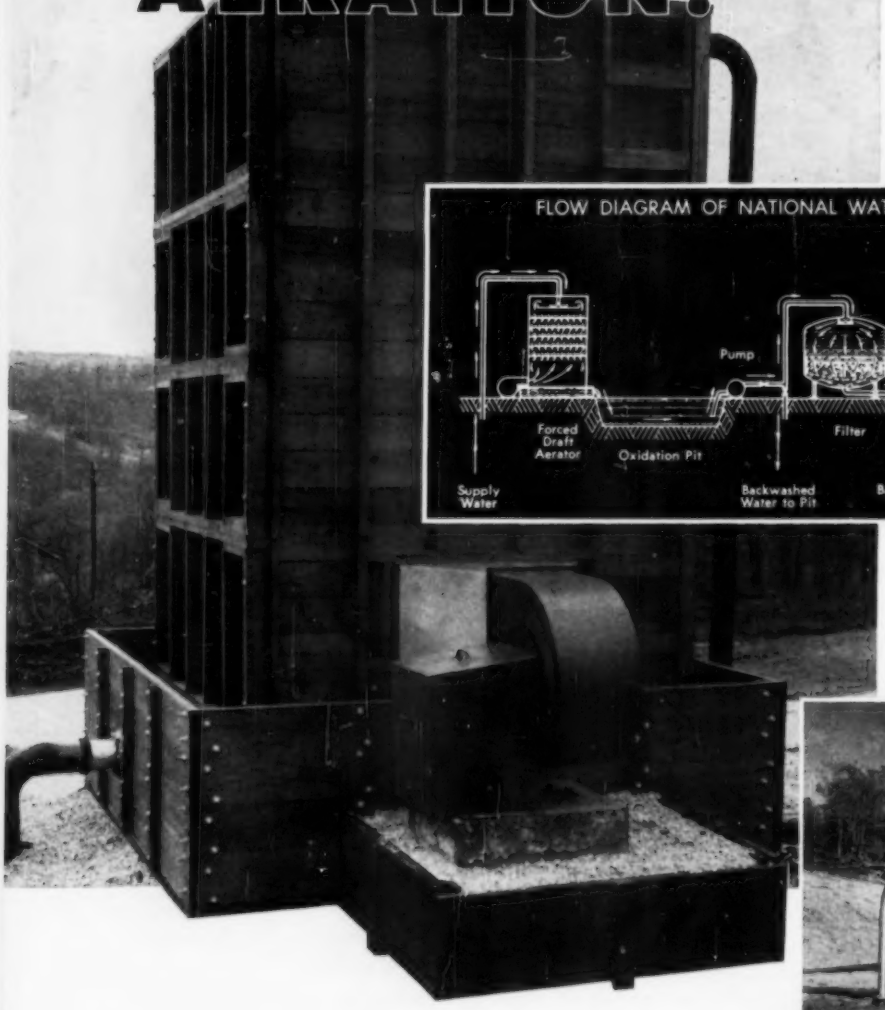
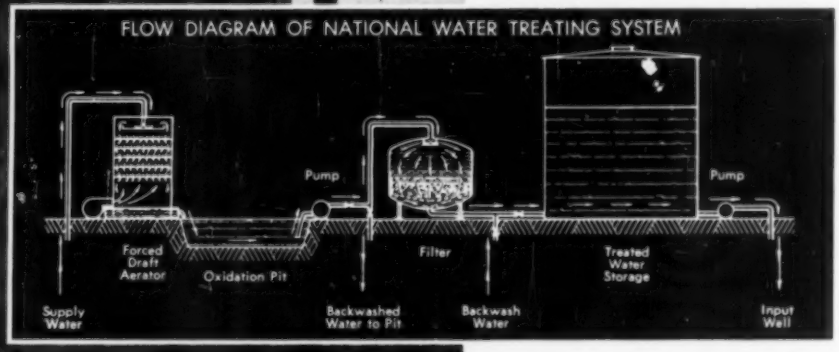
# AERATION!



National Aerator for treating supply water or disposal water in open water system.




Two National Aerators in series with water supply well located north of Tulsa, Oklahoma.

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## NATIONAL "OPEN SYSTEM"

### Salt Water Treating

The National forced draft Aerator is fabricated of redwood with reinforced fiber glass distributor and splash trays, to facilitate ease of and reduce frequency of cleaning. Distribution of water from tray to tray assures liberation of water-bound gases which are expelled to the atmosphere by controlling the volume of air introduced at bottom of the Aerator.

Submerged Aerators are also manufactured by National as are complete closed and open water systems.

*Our Engineering Department welcomes inquiries concerning your water disposal problems.*

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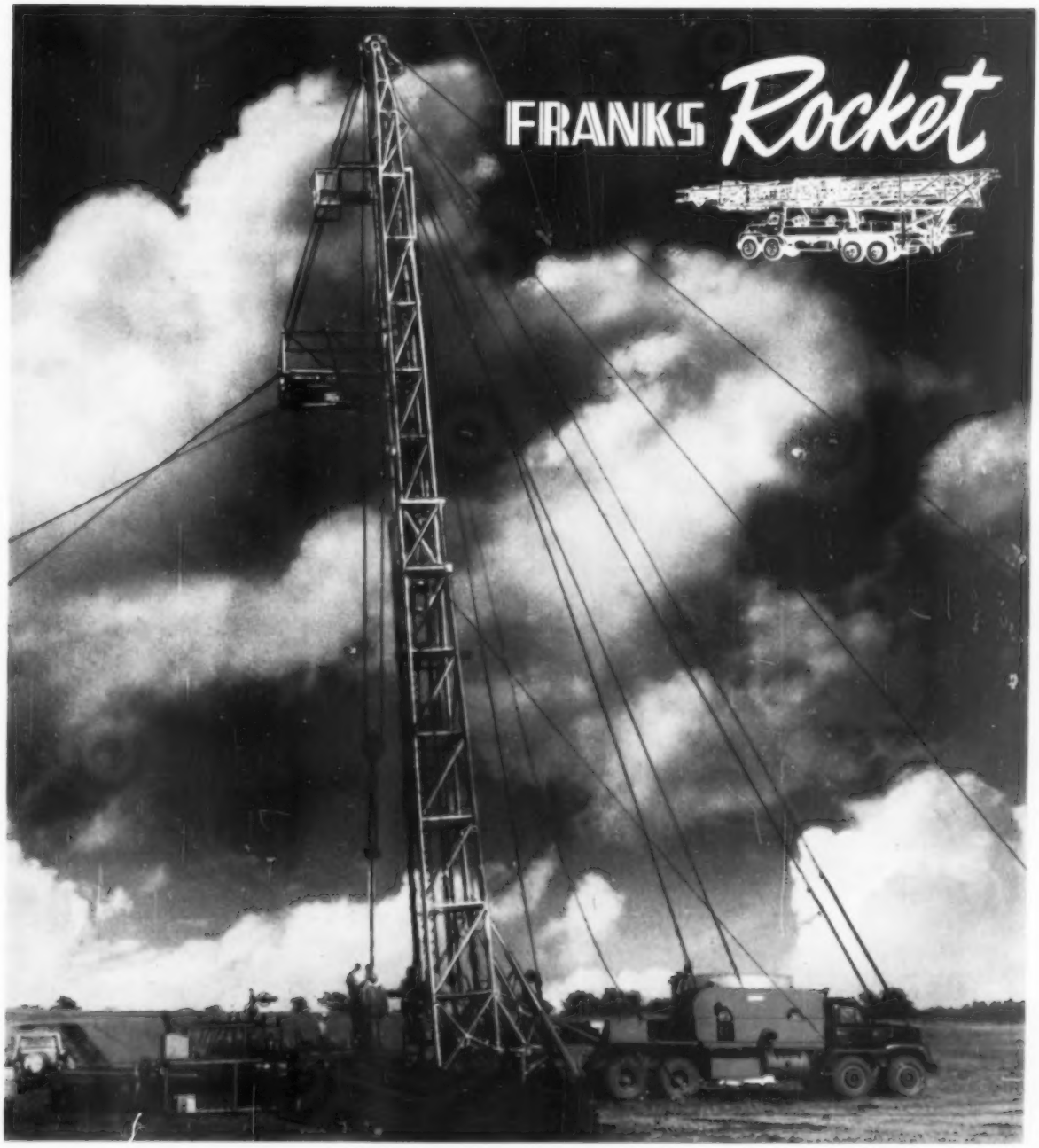


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"On-the-Spot" Field Service

**Of Things To Come . . . . . In Oil**

# A Brighter Horizon For '57

The U. S. oil industry has a brighter horizon to look at now than it has in many Januarys of past years. Turn of recent international events indicates that U. S. oil will again be our "ace-in-the-hole" as it was in World War II. Free enterprise has equipped our industry well not only to meet this critical situation, but to meet the challenge of its own future. There are a few cloudy spots, but the overall oil picture for 1957 looks mighty good in so many ways.

CRUDE OIL PRICES are going up all over the country as much as 40 cents a barrel as a result of the abnormal demand not only to supply our own growing consumption, but to supply the oil needs of England and France. While this might well be a temporary demand increase, it did serve as a catalyst to boost domestic prices in many areas. And, some observers foresee lasting effects even after Suez is opened again.

FOREIGN EXPLORATION is being accelerated particularly closer to home. Around the Caribbean Sea, wildcatting, exploration and bids for concessions have been stimulated . . . and, many independent operators are entering the picture for the first time. Hottest areas include Costa Rica, Panama, Cuba, Trinidad, Barbados Island, Haiti, Colombia, Venezuela and Guatemala. The lesson of Suez should spur on this search close-to-home.

FIELD ACTIVITY AND DEVELOPMENT in the U.S. are headed for higher peaks in 1957. Some forecasters predict that 65,000 wells will be drilled. Any residual price increase after Suez is opened plus the normal expected increase in demand should influence higher activity this year.

STEEL SUPPLY is one of the dark clouds hanging over oil's bright horizon. Tubular goods in tight supply now, will be even tighter this year if activity approaches what experts predict. Wells are going deeper, generally requiring more tons of steel per well. Mills are running at peak capacity and orders have been taken up to 1960. Steel demand is ahead of increasing mill capacity. Operators are gearing field development to make maximum use of available tubular goods, and are expanding their salvage program to complete a record number of wells.

TECHNOLOGY will play a more commanding role in oil than ever before. Last year witnessed many outstanding and near-revolutionary developments in practically all phases of petroleum. Most significant was a new approach to increase oil recovery that will more than double present concepts of ultimate recovery. Many such projects will go into operation this year. Well stimulation by fracturing took another big jump and new developments forecast increase field application. Equipment and product developments were numerous and current research points to a number of big new things. Automatic controls will find increased development and application. The list is big in equipment developments in drilling and production. Every phase of industry is geared for a bigger engineering effort for 1957 to find, drill and produce petroleum more efficiently and cheaper. Look for a number of outstanding developments in technology that will amaze even the optimist.

OFFSHORE, the picture is good. Legal obstacles appear to be hurdled and the road is rapidly clearing for an all-out effort this year. Offshore drilling will break previous records and will be limited primarily by the availability of structures and mobile units.

LEGISLATION appears favorable this year to oil. Oil's role in meeting the current crisis should put it in a favorable light with government whom it helped in time of need. A gas bill will probably pass, the depletion allowance will endure spotty attacks, and the Eisenhower Administration's attitude toward federal control should relieve some tension in oil's behalf.

# AXELSON PICTORIAL

## PUMP RUNS CONTINUOUSLY FOR 32 YEARS, RODS 50 YEARS

The following information was taken directly from P. D. Quinby Oil Company's files on their Well #2, McKittrick, California (shown). On Jan. 12, 1922, an Axelson TL Pump 2" (1¾") with regular cast iron liners and regular steel plunger was run into the well. It ran 24 hours a day for 32 years at 9 strokes per minute. When pulled for the first time in June, 1954, liners and plunger were worn (after 307,152,000 plunger reversals) but balls and seats were in excellent condition.

A new Axelson pump was run back into the well on the same Axelson sucker rod string that had been installed originally in 1905 when the well was completed—over 50 years of continuous sucker rod service!

**HASH STRIPES.** C. E. "Earl" Gwin (right), Production Foreman for P. D. Quinby Oil Company, holds the barrel of the Axelson pump that saw 32 years of uninterrupted service. Orian Myers, well puller, sits beside the plunger assembly. Balls and seats showed very little wear. The new pump is strapped to the car.

**MUSEUM PIECE.** Lee Kulzer, Axelson District Manager, inspects the Axelson sucker rods which were installed in 1905 and are still going strong. The first metal rods were ¾" and ⅞" iron bars with bolt threads on each end. Bolt-threaded couplings held them together. When rods parted, the broken end was cut off with a hacksaw and the end rethreaded with a bolt-thread die. The rod was screwed into the coupling and run back into the well.

**LEADERS.** In front of the Axelson pump rack at the J&L store at Freer, Texas, are Lee Rodgers (left) and Bryan Weaver, Production Superintendent for the Estate of A. A. Buchanan. Rodgers opened this pump shop 22 years ago and for 5 years (1949-54) led all 90 stores in the J&L organization for sales of Axelson pumps and parts. Weaver was Superintendent for Magnolia in Electra, Texas, back in 1924 and used to buy 12 Axelson pumps at a time—"They were cheaper by the dozen, then," he says.

**117 YEARS.** These three old timers, caught chinning in the pump repair shop at Jones & Laughlin's Shreveport store, Louisiana, have been around the oil fields a few years. Hugh White (left) has been with J&L the past 36 years and 4 years with Gulf Oil prior to that. Cleon Worley (center), Axelson District Manager, has been with Axelson for 31 years, 6 with Continental Supply and 7 with Prairie Oil & Gas. J. A. Evans, Jr. (right) roughnecked for 3 years before starting on a 30-year career with J&L. It all adds up to 117 productive years in the industry.

AXELSON
USI

**HARD WORKER.** An Axelson Volu-Max (Maximum Volume) 2½" pump is being run in on the rods to lift 500 B/D of fluid with 30 bbls. of 24 gravity oil. Fluid level is at 900 feet. Cycle is 20 strokes per minute, 40" stroke. This well is in Trinity Field, Texas. Boone Bros. Oil Company is the producer. Volu-Max Pumps are recommended for this kind of hard, fast, high-volume, poorly lubricated pumping.

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*for better production*

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**CALIFORNIA:** *Axelson stores at Bakersfield, Coalinga, Huntington Beach, Long Beach, Orcutt, Santa Fe Springs, Taft, Ventura; Hickey Pipe & Supply Co. (Sucker Rods)* • **MID-CONTINENT:** *Jones & Laughlin Steel Corporation, Supply Division (Headquarters, Tulsa)* **ROCKY MOUNTAINS:** *Jones & Laughlin Steel Corporation, Supply Division; Great Northern Tool & Supply Co., Billings, Montana* • **CANADA:** *Jones & Laughlin Steel Sales Co. Ltd., Calgary; Dominion Oilfield Supply Co. Ltd., Calgary* • **MEXICO, D. F.:** *Wells Fargo & Co. Express, S. A.* • **RIO DE JANEIRO, BRAZIL:** *MAQUIP (Commercial de Maquinas e Equipamentos) S. A.* • **LIMA, PERU:** *Gross Equipment, S. A.* • **LA PAZ, BOLIVIA:** *Del Prado & Compania, Ltd.* • **BUENOS AIRES, ARGENTINA:** *Adrian Bolland & Cia., S. R. L.* • **BARCELONA, VENEZUELA:** *Servicios Industriales, C. A.* • **MARACAIBO, VENEZUELA:** *Servicios Industriales, C. A.* • **BOGOTA, COLOMBIA:** *Servicios Industriales, C. A.* • **TRINIDAD, B. W. I.:** *Industrial Agencies, Ltd.*

# why 100% WAUKESHA

Harry J. Schafer
President
SCHAFER DRILLING CO.
can tell you

SCHAFER DRILLING COMPANY

Liberty Bank Building
OKLAHOMA CITY, OKLAHOMA
Tel. REgent 9-1607

Harry J. Schafer, President

November 1, 1956

Waukesha Motor Company
Waukesha, Wisconsin

Gentlemen:

In my many years as an Oil Producer, I have used almost all makes and types of applicable engines on my wells that were "on the pump." Through the years Waukesha engines have done the most all around satisfactory job for me. I also noticed that the large majority of drilling contractors, drilling wells for me, had Waukesha engines on their drilling rigs.

Therefore, in 1952 when I decided to form my own drilling company, naturally I equipped my first rigs with Waukesha engines. Due to their excellent performance and economy of operation, I have had all of my rigs similarly equipped.

I am proud to say that we are a 100 per cent Waukesha customer. My congratulations on a truly fine product.

Very truly yours,

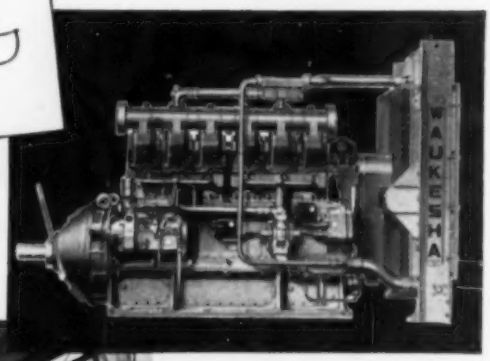
Harry J. Schafer

HJS:ah

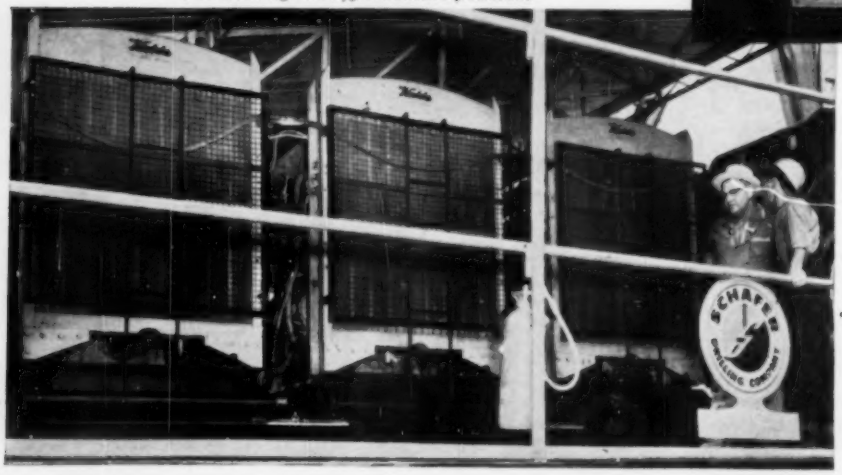
**WAUKESHA**
**Engines and Power Units up to 1135 hp**

**LP Gas • Natural Gas**
**Normal and Turbocharged Diesels**

**SEND FOR BULLETIN 1079**



**Schafer Rig No. 5, drilling at 8,111 ft., Cook No. 2 well, Cement, Okla. This rig, a Unit U-40, has two pumps. Toolpusher Jack (R. J.) Hinchey and Jim Saylor, daylight driller, look pleased with its 3 Waukesha LROU gas power units. Schafer Drilling Co. has seven rigs *100% Waukesha-powered.***

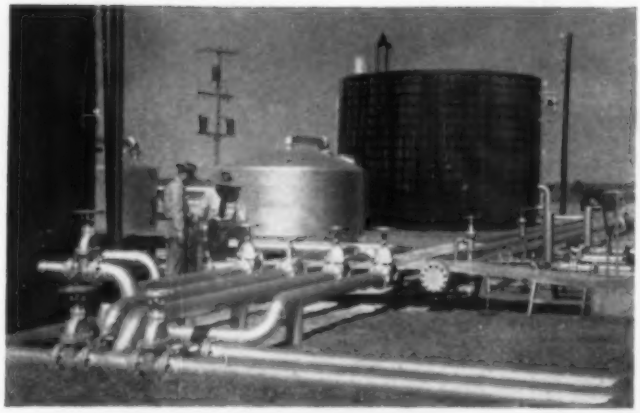


**WAUKESHA Model LRORBU GAS POWER UNIT**—counterbalanced crankshaft, high compression, overhead valve, six cylinders, 8½-inch bore x stroke, 2894 cubic inch displacement. *Send for Bulletin 1560.*

**WAUKESHA MOTOR CO.**
**WAUKESHA, WISCONSIN**
**New York • Tulsa**
**Los Angeles**

329

# Pumping Unit or Whole Production System



The proper selection of production equipment can be simple or complex – depending upon the way it's handled. Done the Bethlehem way, it's simple, for Bethlehem can furnish every item for a production system.

Take, for example, a waterflood layout. First of all, many details of the planning can be handled advantageously by Bethlehem engineers. These are experienced men; they pioneered the development of turnkey waterflooding systems in the Midcontinent. They can help you as they have helped others.

And when it's time for equipment, Bethlehem supplies not only the pumping units, rods, and bottom-hole pumps, but treating and injection facilities, pipe lines, valves, surface pumps, compressors, prime movers, generators, controls, substations, storage tanks, and buildings.

Each system is tailored individually to meet existing conditions. Each is laid out with provision for growth and future needs, and for maximum operating economies.

We can render the same type of service for turnkey electrification systems. Or, if your needs are minor, we'll be glad to furnish as few as two or three pumping units. The point to remember is, we have what you want in production equipment for all kinds of layouts, regardless of size. Whether you're planning something small or a system as big as all outdoors, we suggest you call us.

BETHLEHEM STEEL

BETHLEHEM SUPPLY

BETHLEHEM SUPPLY COMPANY

*General Offices:* 21 E. Second St., Tulsa, Okla.
*West Coast Headquarters:* Los Angeles, Calif.
*Export Distributor:* Bethlehem Steel Export Corporation
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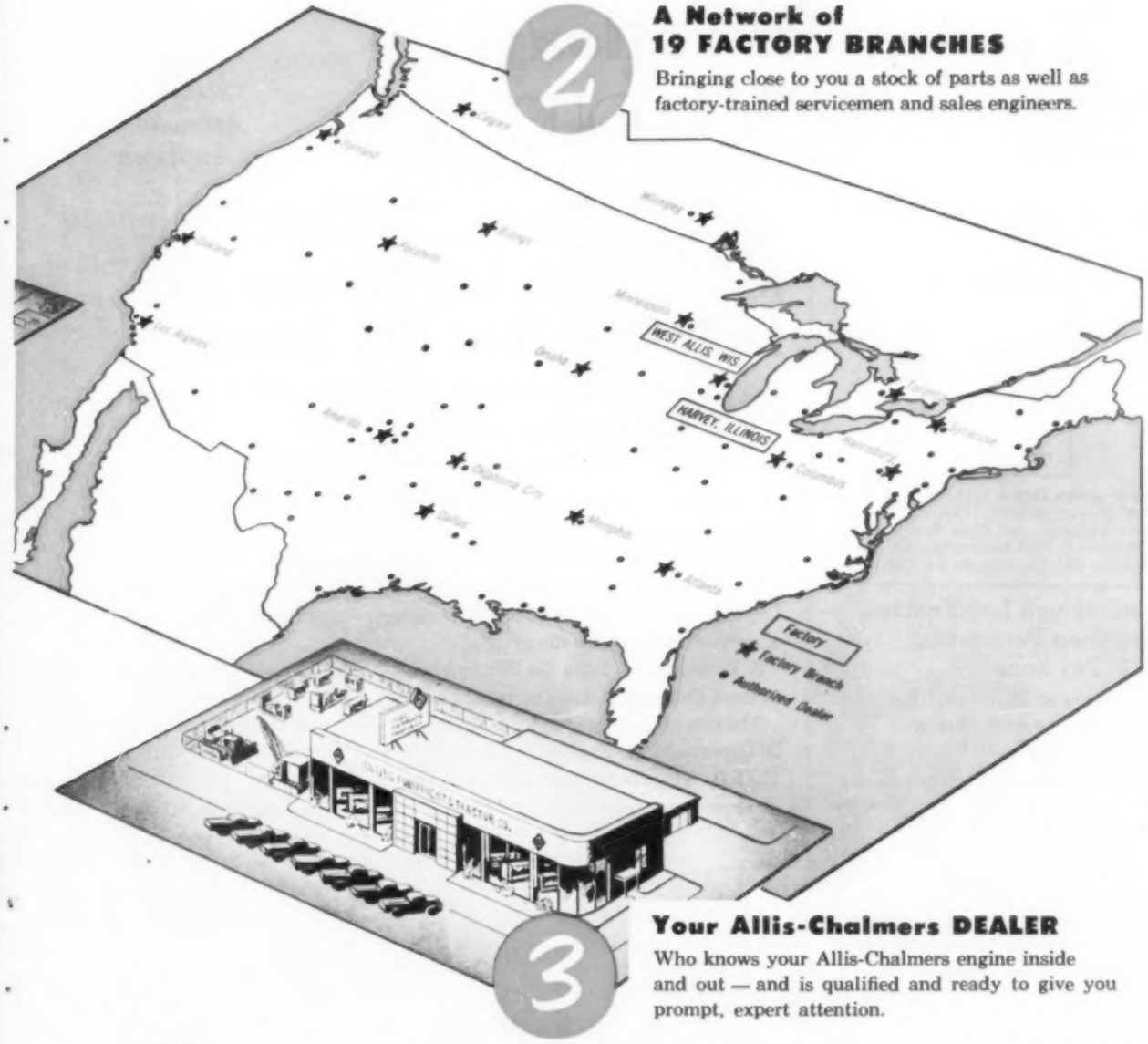
Stocking True Original Parts for continued TOP performance of your Allis-Chalmers engines.

# YOU are backed up 3 deep with parts

# and service...when you use ALLIS-CHALMERS engines!

BE-5


2
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19 FACTORY BRANCHES
Bringing close to you a stock of parts as well as factory-trained servicemen and sales engineers.
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Your Allis-Chalmers DEALER
Who knows your Allis-Chalmers engine inside and out — and is qualified and ready to give you prompt, expert attention.

You enjoy "factory-town" service wherever you are when you operate Allis-Chalmers engines — for you are backed up *3 deep* by Allis-Chalmers' proven dealer-branch-factory system.

What does this mean? It means that your dealer is serviced from one of *19* nearby factory branches—or direct from the factory. Each branch carries a stock of True Original Parts and is staffed with factory-trained servicemen as well as sales engineers. This assures prompt attention whether you need a replacement part or technical assistance.

Ask your Allis-Chalmers engine dealer to show you how this *3-deep* service can help on your specific engine needs. Write for literature and details.

ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

**ALLIS-CHALMERS**

Over 60 *Locations in the United States and Canada*

# McCullough® REPORTS TO THE OIL INDUSTRY

Service® *Anywhere Anytime*

*New Services • • • New Tools • • • New Methods • • • Outstanding Results*

**NOW AVAILABLE** – *Technical paper "A Method for Neutron Derived Porosity Determination for Thin Beds". Write McCullough Tool Company, 5820 South Alameda St., Los Angeles 58, California.*

## McCullough Log Enables Precision Perforating of 5′ Pay Zone

### *Discovers 8′ Error in Electric Log and Casing Measurements*

Operator of this old well ran an electric log which located a new, possibly productive, 5′ sand.

McCullough was then called to run a Neutron Log. The Neutron curve confirmed the productive possibilities of the new zone, but also discovered that both the electric log and casing measurements were 8′ in error.

The well was plugged back to 6800′ and perforated according to McCullough measurements.

Thirty ½" improved Ogival Bullets were shot in the 5′ sand in one run by a 3½" O.D. McCullough M-3 Gun. Casing was 5½" O.D. 17 lb.

The well started flowing through the casing before the M-3 Gun was out of the hole.

If the McCullough Radiation Well Logger had not discovered the 8′ measurement error, the 30 shots would have missed the pay zone entirely.

It always pays to rely on the accuracy and dependability of McCullough's Radiation Well Logger.

# McCullough Log Locates and Defines 11 New Pay Zones

## *Accuracy of McCullough Radiation Well Logger Permits Sharp Shooting of 11 Thin Zones for 138 B/D Increased Production*

This was an old well in an established California oil field. Production had fallen to five barrels of oil per day.

Believing better production was possible, the operator decided to log and re-perforate the well. McCullough's combination Gamma Ray-Neutron Log was run from 4380′ to 5645′, locating several small, promising stringers of untried sands above the original pay zones.

A simultaneous collar log accurately located casing collars in relation to these thin sands, thus assuring "pin-point" accuracy in perforating.

The two original producing sands were re-shot, four holes per foot, with 26 improved ½" Ogival Bullets from McCullough M-3 Guns and with 26 McCullough Standard Casing Glass Jets.

Above these zones were the 11 small sand stringers ranging in thickness from 4 feet to 13 feet. Intermediate zones, lying between the productive sands, which were not to be perforated ranged in thickness from 5 feet to 103 feet.

Accurate measurement means "putting the shots where they count"... and the "pin-point" accuracy of the McCullough Radiation Well Logger makes sharp shooting of thin zones practical... assures uniform perforating coverage of any zone, thick or thin.

The 11 pay sands were perforated with 256 shots, four holes per foot, by 3½" O.D. McCullough M-3 Perforators firing ½" Ogival Bullets. Production increased from 5 to 143 barrels of oil per day.

This is only one of many actual jobs where the accurate, reliable, easily interpreted information provided by the McCullough Radiation Well Logger has located and defined multiple pay zones, tied-in casing collar locations and permitted precision perforating for best possible production.

**McCullough® TOOL COMPANY**

*Cable Address:* MACTOOL

LOS ANGELES
HOUSTON
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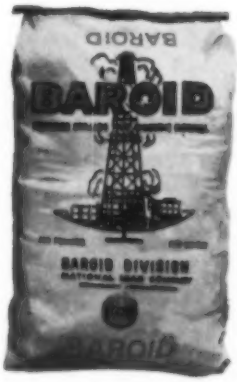
FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

*When you buy Baroid — you buy the best!*




## you buy one— you get F UR

*Only Baroid gives you so much for your mud dollar. Service begins with an engineered mud program before you drill.*

*During operations, Baroid's 24-hour service speeds drilling, prevents trouble, and saves you money.*

*Complete well reports are filed at Baroid Area Headquarters for planning your future mud programs.*

Mud that costs you less is mud backed by the best service — Baroid service. Your total mud program works better, saves you money when you use Baroid all the way. Baroid area headquarters give you fast, complete, localized service. Your best mud buy is BAROID!

BAROID

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# FIBERTEX

For preventing or curing lost circulation, nothing equals FIBERTEX...continuously and scientifically improved to seal thief zones. FIBERTEX outsells all other lost circulation materials because it securely seals against the formation; doesn't clog or abrade pumps. Don't waste time experimenting ... use FIBERTEX first!

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BAROID

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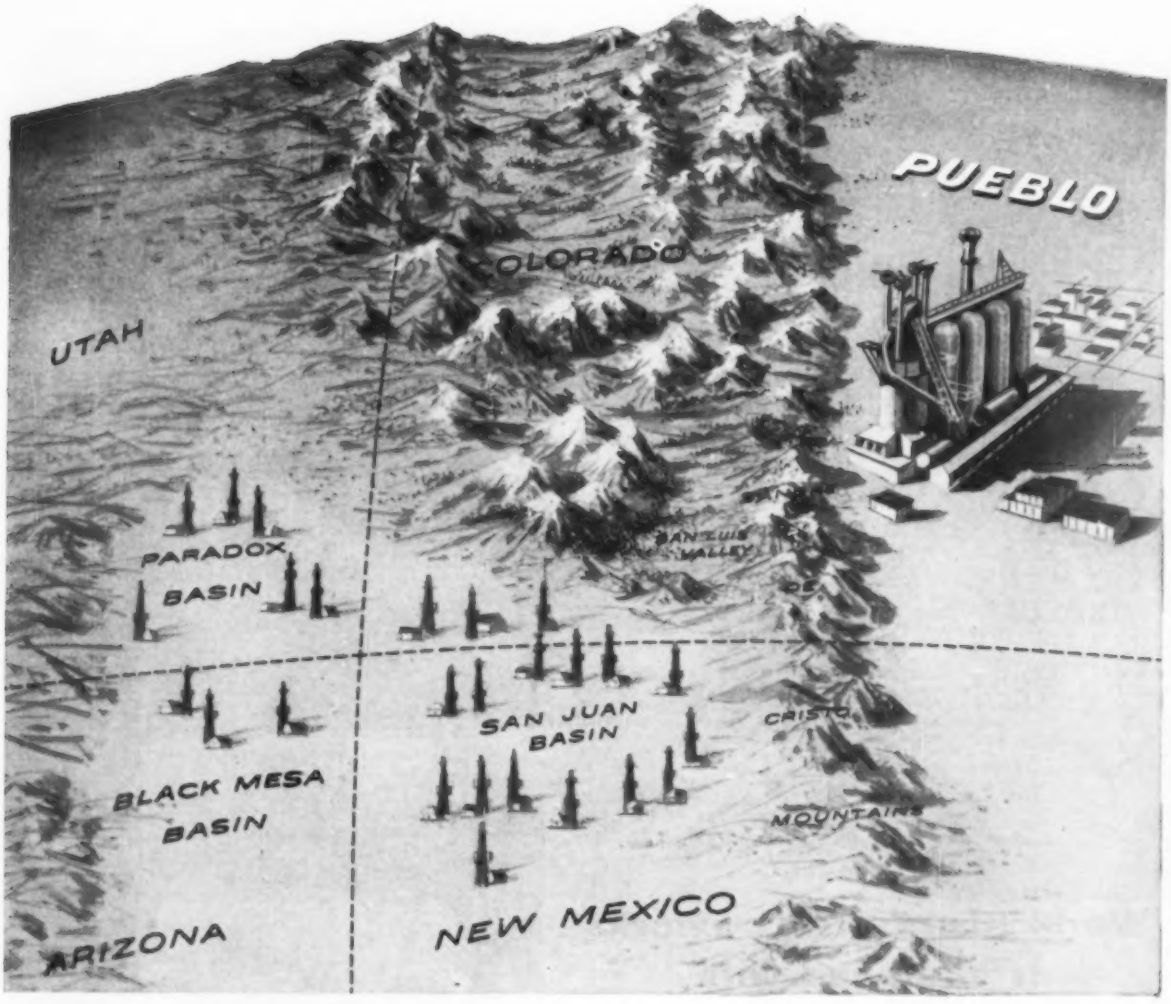


## you'll see

# CF&I SEAMLESS CASING AND TUBING

## throughout the four corners area

Take the San Juan Basin . . . or the Paradox Basin . . . or the Black Mesa Basin . . . or any other active part of the Four Corners Area. There you'll find CF&I Seamless Oil Country Casing and Tubing. For operators all over this important producing and exploration area have found that CF&I's conveniently located Seamless Tube Mill offers them top-quality casing and tubing.

CF&I Seamless Oil Country Casing and Tubing is available in 2⅜" through 9⅝" O.D. It meets or exceeds API STD 5A specification.

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**SEAMLESS TUBULAR PRODUCTS**
THE COLORADO FUEL AND IRON CORPORATION
Denver, Colorado

CF&I

MOBILE PLATFORM of new offshore drilling firm is outfitted with . . .

## World's Largest Draw Works

HOUSTON.—The largest draw works ever built has been installed on a mobile drilling platform being built here for Morris & Hamilton, Inc., newcomers in the offshore drilling business.

The draw works is incorporated in a Wilson Manufacturing Co. Super Titan "66" rig, which is one of the largest ever manufactured. Driven by 2,400 hp., the rig is designed for drilling to 20,000 ft. with 4½-in. drill pipe. With use of 3½-in. pipe it has a depth rating of 25,000 ft.

Independent diesel engines driving the rotary and mud-mixing pumps bring total available horsepower on the entire rig to more than 3,600.

The Lee C. Moore cantilever-type mast has a capacity of more than 1,000,000 lb.

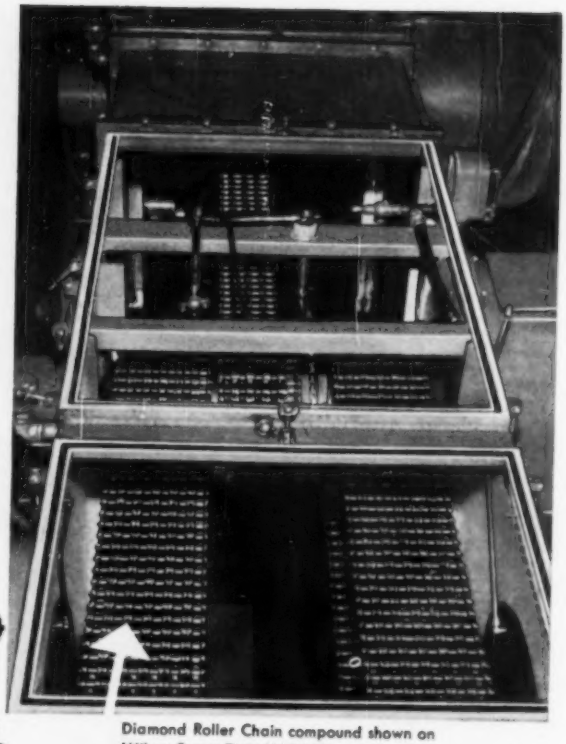
Designed for operations in 30 ft. of water, the platform is Morris & Hamilton's first unit for drilling in the open gulf. The Houston-based company now operates one bay barge and three land rigs.

The mobile platform was dedicated August 17. It is scheduled to leave soon to start drilling for The Texas Co. in 30-ft. water off the Louisiana coast.

Hull of the vessel is 230 ft. long, 99 ft. wide at one end, 75 ft. wide at the slot end, and 11 ft. 9 in. deep. The lower of two decks on the platform is 65 ft. above the bottom of the basic hull. Deck structures are supported by fixed columns.

Sprague Welding & Machine Works employed an unusual technique in constructing the vessel. The upper structure was built on top of the lower hull deck. Then columns were erected and hydraulic jacks raised the superstructure to its present position.

*Reproduced from "Oil & Gas Journal" article*



Diamond Roller Chain compound shown on Wilson Super Titan "66" Rig.

Dewey Morris of Morris and Hamilton; and John Wilson, President, and Jack Wilson, Assistant to the President, of Wilson Manufacturing Company.

# World's Largest Drawworks is equipped with DIAMOND ROLLER CHAINS

Diamond Roller Chains are first choice for tough jobs like this because they deliver power dependably, economically and efficiently over a longer service life. Records prove there is no substitute for Diamond's uniform high quality.

Leading Oil Country stores can give you fast service. Ask for Diamond and get the best.

**DIAMOND CHAIN COMPANY, Inc.**

*Where High Quality is Traditional*

**Dept. 441, 402 Kentucky Ave., Indianapolis 7, Indiana**

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**Please refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER**

DIAMOND ROLLER CHAINS

Dowell engineer controls the powerful Allison with remote panel.

# MUD ACID

## gives frac jobs a running start

For best results, fracturing fluid must enter the pay zone with enough velocity to carry its cargo of sand deep into the formation. Often, when the sand-laden fluid enters a "mudded off" formation, fluid velocity is decreased and the sand is "screened out" in the well bore. The result may be a poor fracturing job.

This situation can be avoided by using Mud Acid as a spearhead for fracturing. Mud Acid, a combination of hydrochloric and hydrofluoric acids, has the ability to dissolve or disintegrate drilling mud materials, such as bentonite. This permits fracturing fluids to enter the formation at reduced pressures and higher velocities. It also provides better distribution of the sand and increased permeability in the critical area surrounding the well bore.

Versatile Mud Acid is also used to open mud-fouled screens and liners and to free stuck drill pipe. It is an effective spearhead to clean up the well ahead of squeeze cementing operations.

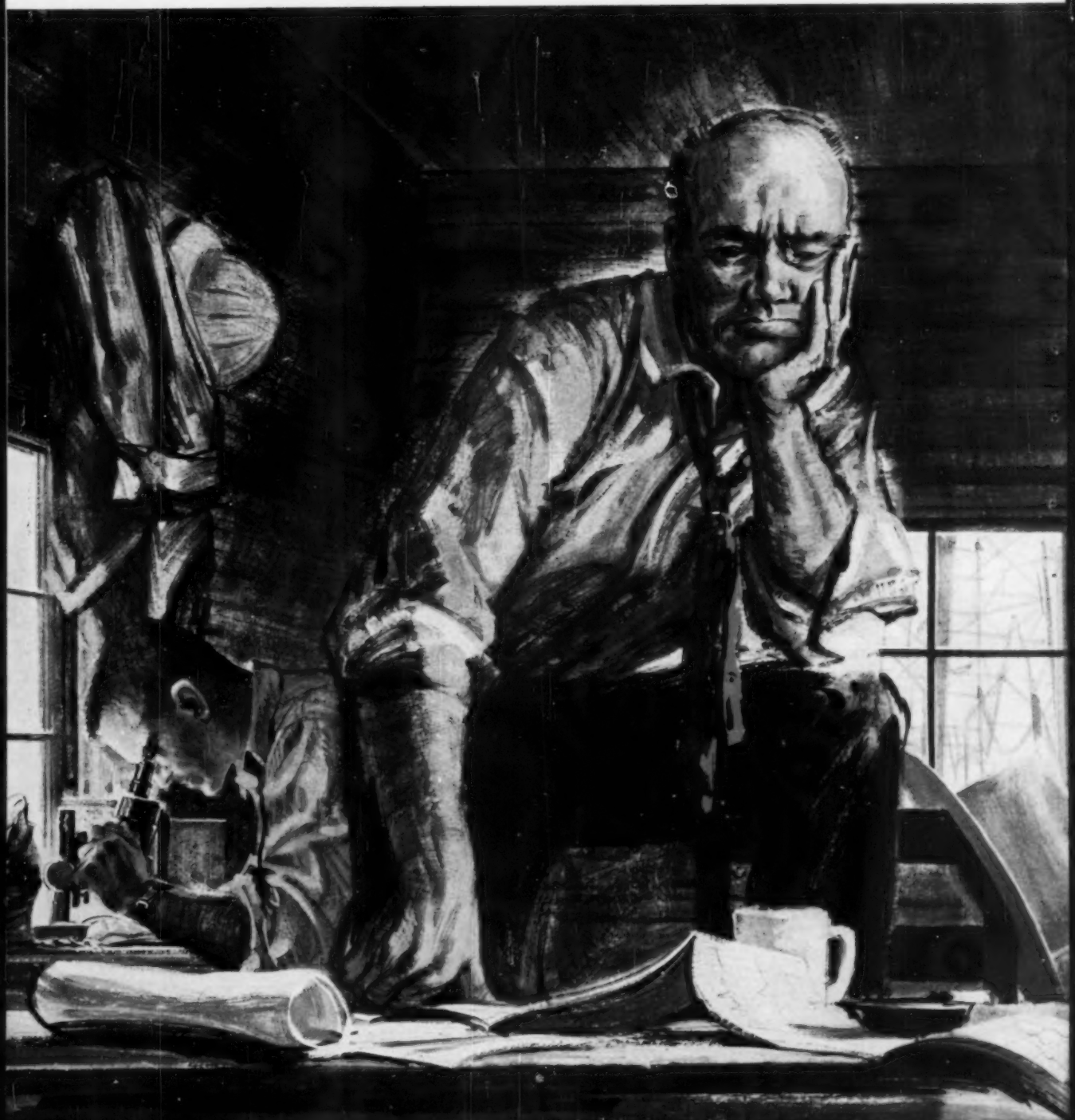
For more information on the many uses of Mud Acid, call any of the 165 Dowell offices in the United States and Canada; in Venezuela contact United Oilwell Service. Or write to Dowell Incorporated, Tulsa 1, Oklahoma.

*Services for the oil industry*

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

*To set pipe or not to set pipe.....*



# .... has this ever been your $64,000 question ?

Few indeed are the oil men who have been spared the necessity of making this decision. The well in question may be a wildcat. Perhaps it is a stepout from a proven field. There are some indications of *possible* oil or gas production. A lot of money is riding on your decision.

In such cases you need every ounce of *accurate* formation data possible to obtain. True formation pressures are a must. Inaccurate pressure indications could influence you to abandon a commercially productive well. Or they might cause you to set a string of costly pipe and send mo[illegible] good money after bad.

Helping operators answer this tough question is old hat with Johnston (29 years to be exact). The Tension Type Pressure Recorder used *exclusively* with Johnston Formation Testers is so sensitive that it faithfully records pressure changes of as little as *five one-hundredths of one per cent!* A rugged built-in thermometer and clock leave absolutely no need for guess work or approximation.

Whether it is a well of questionable productivity or a well in a proven reservoir, you want the truth and nothing but the truth insofar as formation pressures are concerned. That's what you get with a Johnston Test . . . not approximate pressure values.

## JOHNSTON TESTERS

**first in drill** JOHNSTON **stem testing**

P. O. BOX 98,
**HOUSTON, TEXAS**
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*A Subsidiary of Schlumberger Well Surveying Corporation*

THERE'S A DIFFERENCE IN DRILL STEM TESTING . . . AND JOHNSTON MAKES THE DIFFERENCE!

# *Prevent Casing Failures*

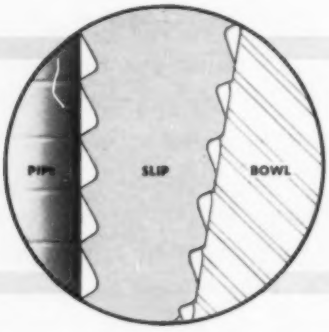
**SPECIFY and USE**

# *McEvoy "Controlled Friction" Casing Hangers*

Your well investment is no safer than the Well Head Equipment and Casing Hangers which support your casing strings. Like good insurance in a safe, sound company, good Casing Hangers dependably protect your investment every minute of the day and night. They work for you without attention or care for years and years . . . for the entire life of your wells. Your wells deserve the best, most reliable, and in the long run, the cheapest . . . McEvoy's unique, exclusive and unrivaled "Controlled Friction" (CF) Casing Hangers. Easily recovered, completely salvageable.

**The only Engineered Hangers with Capacity Curves available—write for details and data . . . then compare!**

A set of McEvoy new revolutionary "CF" Slips, showing both inner (sharp) and outer (dull) teeth. You can see that these outer teeth are not merely "rough machined", but are actual precision-made teeth that controllably engage the slip-bowl.




Sectional view showing McEvoy "CF" Slips, with sharp teeth on one side securely supporting the casing, and dull teeth on other side which control the slip-bowl friction, and automatically limit the downward movement of the slips in their bowl.

**Casing pressures, test pressures, or high pressure remedial work cannot load the slips or change their pipe load capacity. Hydraulic and mechanical loads are completely separated.**

# *Available for all wells*

**FOR THE WORLD'S DEEPEST WELLS**

McEvoy SB-2 Casing Hangers were developed through extensive research, and have proved the complete answer to every deep, high pressure, heavy string need. May be wrapped around the pipe and dropped through the preventers, automatically **set** and **seal,** providing the ultimate in safety. Will safely support **any casing string that can be picked up in the derrick.**

**FOR MEDIUM DEPTH WELLS**

McEvoy Type CB or CB-2 Casing Hangers were designed and are fully field proven for handling all medium and medium-heavy casing strings in complete safety to the full strength of short thread API couplings. They satisfy a long felt user need for simple, functional and dependable lower cost casing hanging equipment.

**McEvoy "CF" Hangers have been proven and demonstrated . . . Let us show you.**

## McEvoy COMPANY

OIL WELL EQUIPMENT

**TEXAS AND MILBY ST. • P. O. BOX 3127 HOUSTON 1, TEXAS**



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

# You Need The Model MDH

BS&B LOW TEMPERATURE SEPARATION

# COLD-FRAC* SYSTEM

## When Your Gas Condensate Wells...

**1 Are Extremely High Pressured**

MDH COLD-FRAC Systems will give condensate recoveries comparable with more elaborate low temperature separation systems when the pressure reduction across the choke is sufficient to produce a temperature drop of 80° F. or more. This is normally obtained with inlet pressures of 4,000 psi or more and with the low temperature separator operated at approximately 1,000 psi or less. Special heat exchanger achieves maximum cooling with minimum pressure drop through counterflow with cold sales gas.

**2 Produce Wax and/or Salt Water**

The highly efficient BS&B Model DC Liquid Knockout is an integral part of the MDH COLD-FRAC System. It effects maximum scrubbing efficiency by removing particles 10 microns in size and larger. This inlet knockout handles the maximum rated gas capacity without carryover while handling a normal volume of liquid. Waxy oils and salt water are efficiently removed and bypassed around the heat exchanger and choke, eliminating operating problems and refrigeration losses.

**3 Have A Pressure Life of 3 to 5 Years**

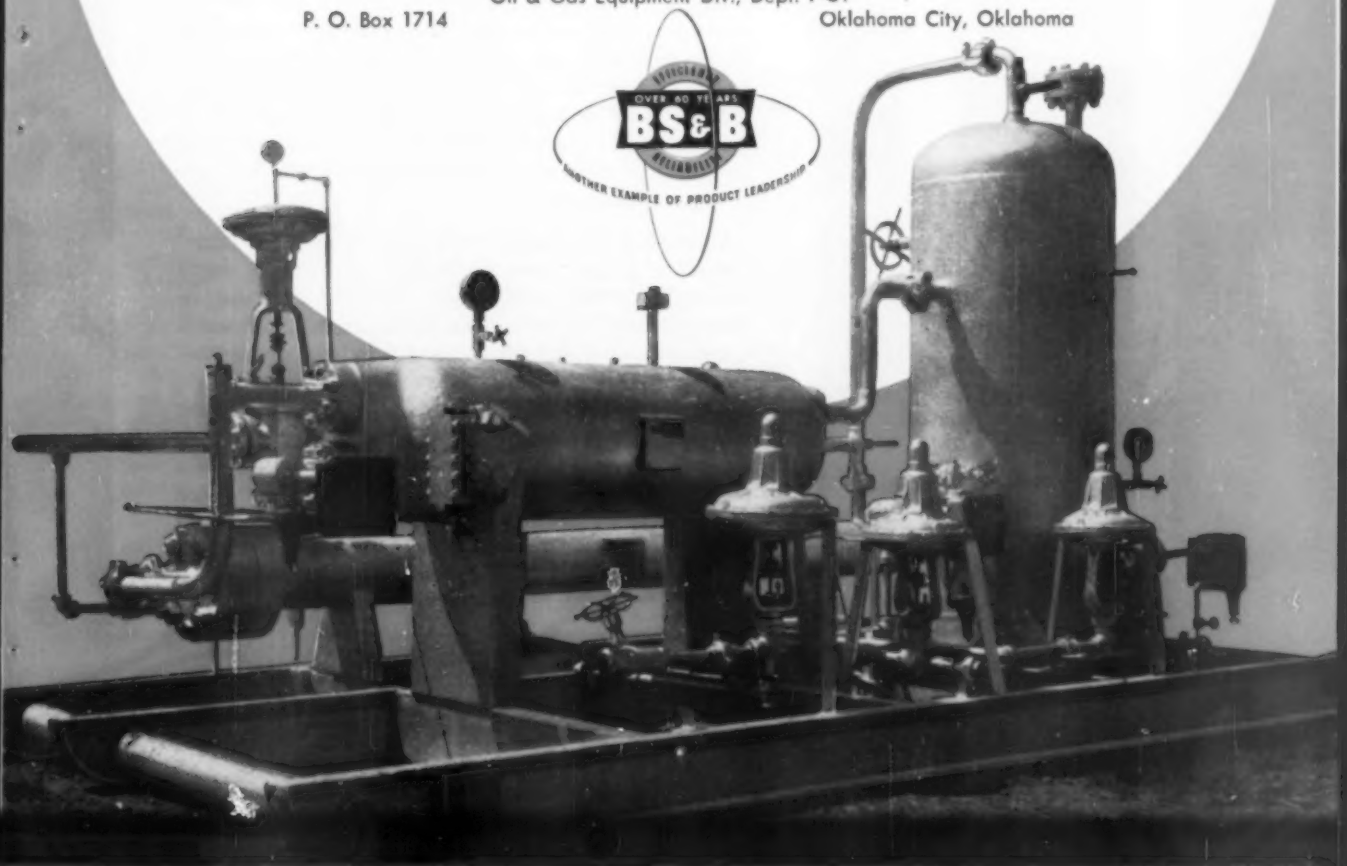
MDH COLD-FRAC Systems are especially suitable for wells with a pressure life of 3 to 5 years, which normally maintains the proper balance between initial cost and added recovery. If the pressure life of the well is less than 3 years, the BS&B ECON-O-MAX unit should be considered; if more than 5 years, the GDH COLD-FRAC (with hydrate inhibitor) will insure maximum recovery throughout the extended life of the well.

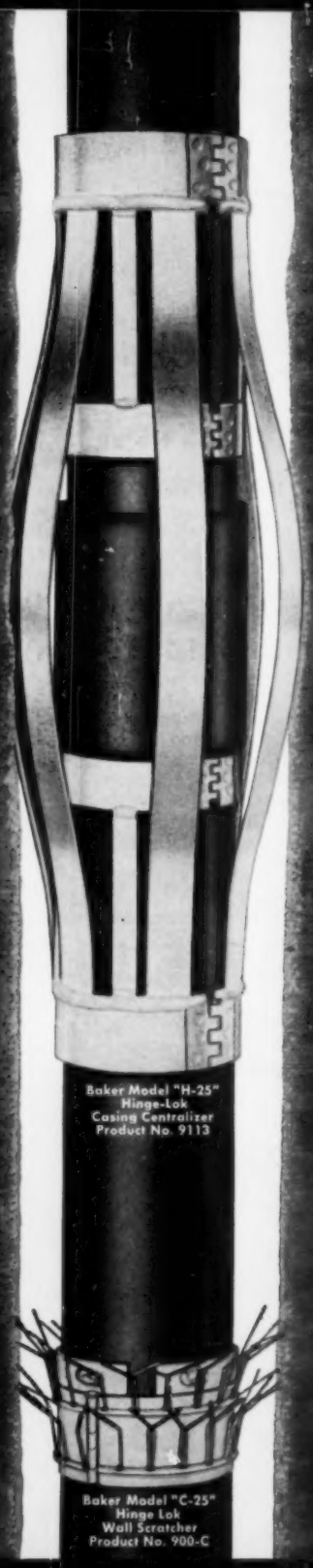
**Ask Your BS&B Representative For Details, Or Write To...**

## BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Div., Dept. 1-C1

P. O. Box 1714 Oklahoma City, Oklahoma






# Here's that *Outstanding Combination*

## for BETTER primary cementing...

... BAKER CASING CENTRALIZERS to provide clearance for a uniform body of cement around the casing—and BAKER WALL SCRATCHERS to scratch away the mud cake and expose the formation for better bonding of the cement.

### EFFECTIVE CENTERING

BAKER CASING CENTRALIZERS have a balanced combination of proper spring *length*, and proper *bowed height* to provide EFFECTIVE CENTERING FORCE over the entire area to be cemented. And each spring is pre-tested and pre-set to ensure having this Vital Centering Force *at the cementing point* regardless of depth or hole deviations.

### CONTROLLED SCRATCHING

BAKER WALL SCRATCHERS perform a "Controlled" scratching job because the wires remain close against the casing while running in the hole and *do not damage the vital filter cake* on the way down the hole. Only when the actual "wall scratching operation" is commenced, do the overlapping wires (mounted in a strong DOUBLE shell) go to work scratching away the mud sheath and exposing the formation for *far better bonding* of the cement.

### AVAILABLE IN EXACT TYPE AND SIZE REQUIRED

Baker Casing Centralizers are available in either the hinged (Model "H" HINGE-LOK, Product No. 9113, illustrated) or slip-on (Model "G", Product No. 910-G) models, each with a complete range of spring-bowed heights for each casing OD—one exactly right for most casing clearance programs. Baker Model "C" Wall Scratchers are also available in either the hinged (Model "C" HINGE-LOK, Product No. 900-C, illustrated) or slip-on (Model "C" Solid Ring, Product No. 901-C) models with your choice of 2½-inch (C-25) or 4½-inch (C-45) scratcher wires. Ask your Baker Representative about this *outstanding combination* for better primary cementing.

**BAKER OIL TOOLS, INC.** • HOUSTON • LOS ANGELES • NEW YORK

# BAKER

## WALL SCRATCHERS
## CASING CENTRALIZERS

**In the Vacuum Field of Lea County, New Mexico**

# Air Drilling Pays Dividends

Magnolia's experience in three wells indicates straighter hole, fast penetration, fewer bits and a direct saving on drilling costs of $5875. Problems arose in logging and coring

**LeRoy Radford**
*Magnolia Petroleum Company*
*Midland, Texas*

SUCCESSFUL air drilling of three 4500-ft wells in the Vacuum pool, Lea County, New Mexico, has led the Magnolia Petroleum Company to adopt new methods for drilling all new wells in the field, calling for air to be used as a circulating medium. These operations mark the company's entry into air drilling.

Expansion and continuance of the program is based on three wells analyzed here, on actual equipment utilized, performance and economics of this technique in comparison to wells drilled in the same field using conventional methods.

As this report is made, two present wells have been drilled using this technique, and a third one was partially drilled with air. One successful coring operation has been completed.

From evidence accumulated in the drilling of these wells, Magnolia has counted several savings: In rig time, as a result of faster penetration rate and fewer trips; bits; less wear on equipment; fuel costs; mud materials; cement, and water (where critical).

Only additional cost entailed in this operation is the cost of air compressor equipment, circulating head, and manifolding. In the West Texas area all of these items are available on a contract rental basis.

West Texas operating companies and drilling companies presently are utilizing air drilling in some areas. In the areas where these operations have been successful, considerable savings have resulted from the use of this tech-

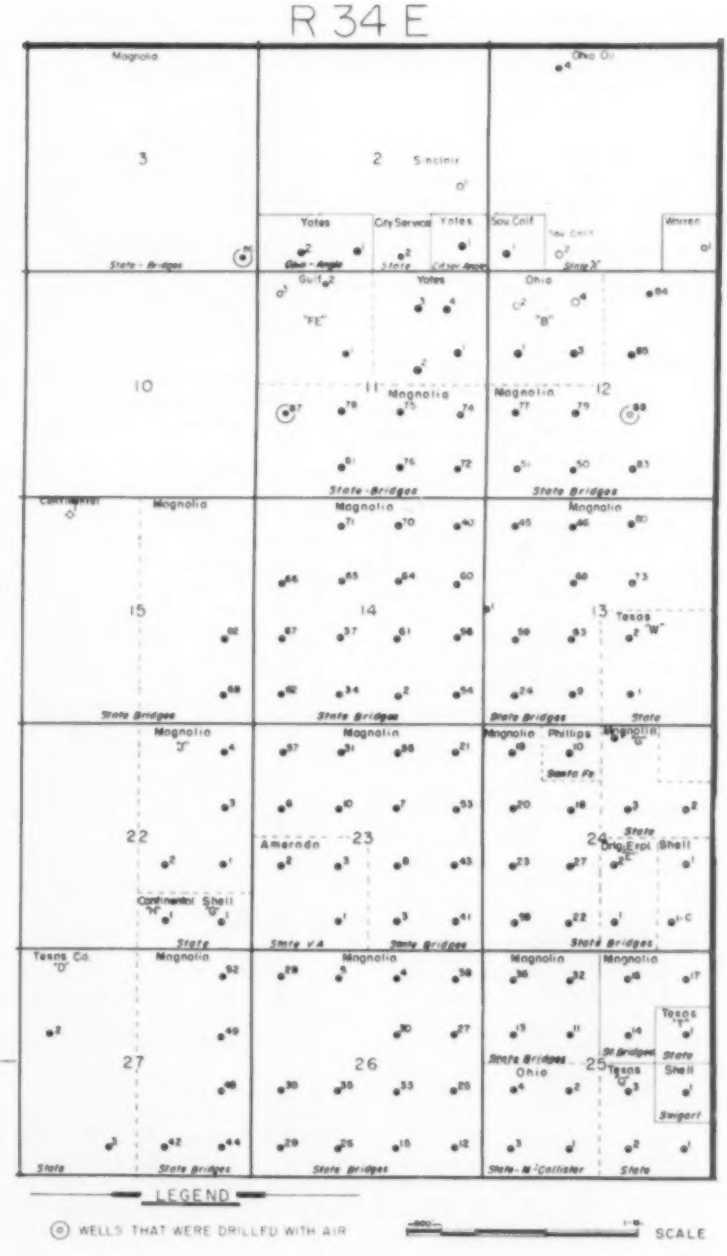



FIG. 1. **Vacuum field,** in the western part of Lea County, New Mexico, was the testing ground for the company's first air drilling. Wells No. 86, 87, and 88 were air drilled. For comparison purposes, conventionally drilled wells No. 78, 81, and 85 were used.

nique. Successful operations, however, have been carried out only where water productive formation was penetrated.

### Field Characteristics

The Vacuum field is located in the west central part of Lea County. The San Andres formation of Permian age is the producing zone and varies in depth from 4500 to 4800 ft subsurface. General practice in this area calls for casing the red bed section and setting about 1600 to 1700 ft of 8⅝-in. surface casing into the top of the salt section. Below surface casing, a 7⅞-in. hole is drilled to immediately above the San Andres formation where 5½-in. casing is cemented. The San Andres pay is then diamond cored using a 4⅝-in. by 2¼-in. core head and the well is completed in the open hole. The lithology below the surface pipe consists generally of salt, shale, and anhydrite down to approximately 3000 ft. Below this depth the section is predominantly lime and dolomite with anhydrite inclusions. No water bearing zone sufficient to cause water invasion of the hole exists below 1600 ft.

The drilling fluid used has followed the following general program. Native mud was used to the 8⅝-in. casing point. Saturated salt water was used to approximately 4000 ft at which time starch and gel were introduced to give a mud of 40-45 sec funnel viscosity and less than 10 cc fluid loss. This program has given satisfactory results with a mud cost of approximately $0.50 per foot.

Magnolia holds considerable leases in this field and has maintained one rig in operation in this area for the past year. In an effort to reduce drilling costs, air drilling was investigated for use in drilling operations in this area. Three wells, State Bridges No. 86, State Bridges No. 87, and State Bridges No. 88 were selected for drilling by this method.

The Queen sand is encountered at approximately 3800 ft. This sand produces some gas throughout the field and even though it is not of commercial importance, because of the high nitrogen content of the gas, it sometimes produces a large volume initially. This gas was encountered in all three wells. On State Bridges No. 86 and State Bridges No. 88, the gas was ignited and drilling operations continued. The amount of gas diminished throughout the operation and was never a serious threat. A leak in a blowout preventer developed after this sand had been penetrated on the State Bridges No. 87 which created a hazard that could not be readily controlled, so it was decided that the well should be mudded up in the interest of safety.

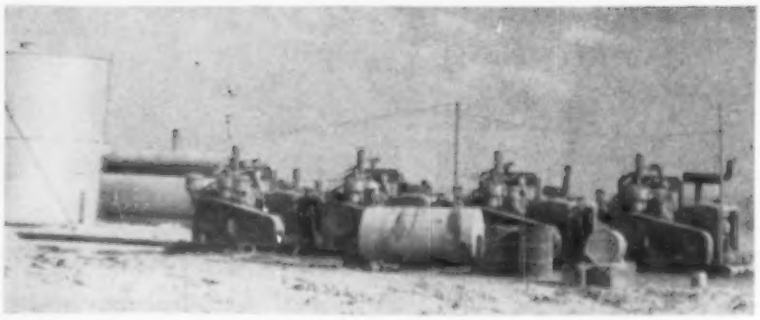


FIG. 2. **Compressor equipment** used in air drilling the Vacuum field wells were four 525 cfm units, in parallel, skid-mounted, single stage units.

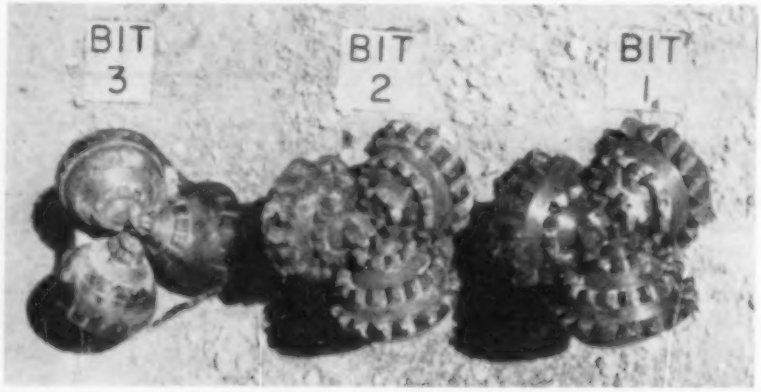



FIG. 3. **Three of the four bits** used in drilling the State Bridges No. 86 are shown here. First was pulled when the bit became plugged; the second was pulled medium dull; the third was dull.

### Procedure

Drilling equipment normally used was employed for this operation and supplemented with compressor equipment to furnish air.

Installation of the compressor equipment did not involve any basic changes in hookup. A line was installed from the compressor manifold to the standpipe and connected at this point. The master valve to the mud pump was closed. A bleed-off valve was installed at the standpipe to facilitate bleeding off the air pressure during connections. A circulating head was installed to deflect the flow of gas and cuttings to the flow line, and due to presence of the Queen gas sand, about 300 ft of flow line was used.

The surface casing (8⅝-in. to approximately 1650 ft) was set using regular drilling fluid and the float collar and shoe were drilled with fluid. After this was accomplished, the hole was displaced with air by stages of approximately 500 ft.

The drilling techniques employed were similar to those employed using fluid with only minor exceptions which will be discussed later in the article.

### Compressor

In addition to normal drilling equipment, the following compressor and supplementary equipment was used: Four 525 cfm compressors powered by four 130 hp diesel engines (engines changed to 170 hp gas engines for State Bridges No. 87); a rotating head, and manifolding for operation.

Only three of the compressors were used for normal operations with the fourth being used as a standby unit.

In drilling the State Bridges No. 88, two compressors of 750 cfm capacity at 250 psi were used.

In all instances the capacity of the compressors was sufficient to maintain

**The Author**

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an annular velocity in excess of 4000 ft per minute at less than 100 psi standpipe pressure. At no time was difficulty encountered in maintaining a dry hole or in removing cuttings.

### Drilling Technique

Very few problems were encountered in the use of air as a circulating medium. Weight carried on the bit amounted to 20,000 lb to 30,000 lb and rotary speed was held at approximately 80 rpm. Air pressure varied from 60 to 75 psi (measured at the standpipe) at approximately 1500 cfm.

### Bits

Four bits were used in drilling the interval from 1658 to 4691 ft on the State Bridges No. 86. Mechanical difficulty with the blowout preventer caused the State Bridges No. 87 to be mudded up at 4033 ft. Two bits were used on this well from 1660 to 4033 ft where the well was mudded up. Four bits were used on State Bridges No. 88.

The first bit was pulled because it had become plugged. The second bit was only medium dull and the third bit was dull. It was necessary to ream about 40 ft drilled by the third bit in addition to drilling from approximately 4630 to 4671 ft with the fourth bit. The fourth bit was dull.

The two bits used on the States Bridges No. 87 were medium dull. The first two bits used on the State Bridges No. 88 were medium dull and the last two bits were dull.

A comparison of bit cost and footage on several wells in this field is given in Table 1.

In comparison, the three wells on which mud was used drilled an average footage of 3009 ft per well, used 16.3 bits for an average of 189 ft per bit, while the two wells drilled with air drilled an average footage of 2994 ft per well, used 4 bits for an average of 901 ft per bit. The bit cost on those wells drilled with mud averaged $0.81 per foot and the bit cost on the two wells drilled with air averaged $0.20 per foot. A complete breakdown of this information is given in Table 1.

### Penetration Rate

The penetration rate was increased by a considerable extent through the use of air as a circulating medium.

A comparison of drilling time between State Bridges No. 81, which was drilled with mud and State Bridges No. 86 and State Bridges No. 87, both drilled with air is given in Fig. 4. At all depths the drilling rate on those wells where air was used is faster than on that well where mud was used. As the depth increases, the comparison shows that the drilling rate on those wells where air was used decreases much

**TABLE 1—Bit Cost Comparison of Mud vs Air Drilling**

| Well Name and Number | Interval Drilled From | To | Footage | No. Bits Used | Average Footage per bit | Cost of Bits $ | Bit Cost Per Foot $ |
|---|---|---|---|---|---|---|---|
| MUD: | | | | | | | |
| State Bridges No. 78 | 1670 | 4675 | 3005 | 17 | 177 | 2550 | 0.85 |
| State Bridges No. 81 | 1651 | 4710 | 3059 | 18 | 170 | 2700 | 0.88 |
| State Bridges No. 85 | 1685 | 4675 | 2990 | 14 | 214 | 2100 | 0.70 |
| | | Average | 3018 | 16.3 | 189* | 2445* | 0.81* |
| AIR: | | | | | | | |
| State Bridges No. 86 | 1658 | 4691 | 3003 | 4 | 758 | 600 | 0.20 |
| State Bridges No. 88 | 1710 | 4665 | 2955 | 4 | 739 | 600 | 0.20 |
| | | Average | 2994 | 4 | 749* | 600* | 0.20* |
| COMBINED MUD AND AIR DRILLING: | | | | | | | |
| State Bridges No. 87 | | | | | | | |
| Air | 1660 | 4033 | 2373 | 2 | 1187 | 300 | 0.13 |
| Mud | 4033 | 4695 | 662 | 7 | 95 | 1050 | 1.59 |
| TOTAL | | | 3035 | 9 | 337* | 1350 | 0.45* |

*Weighted Average

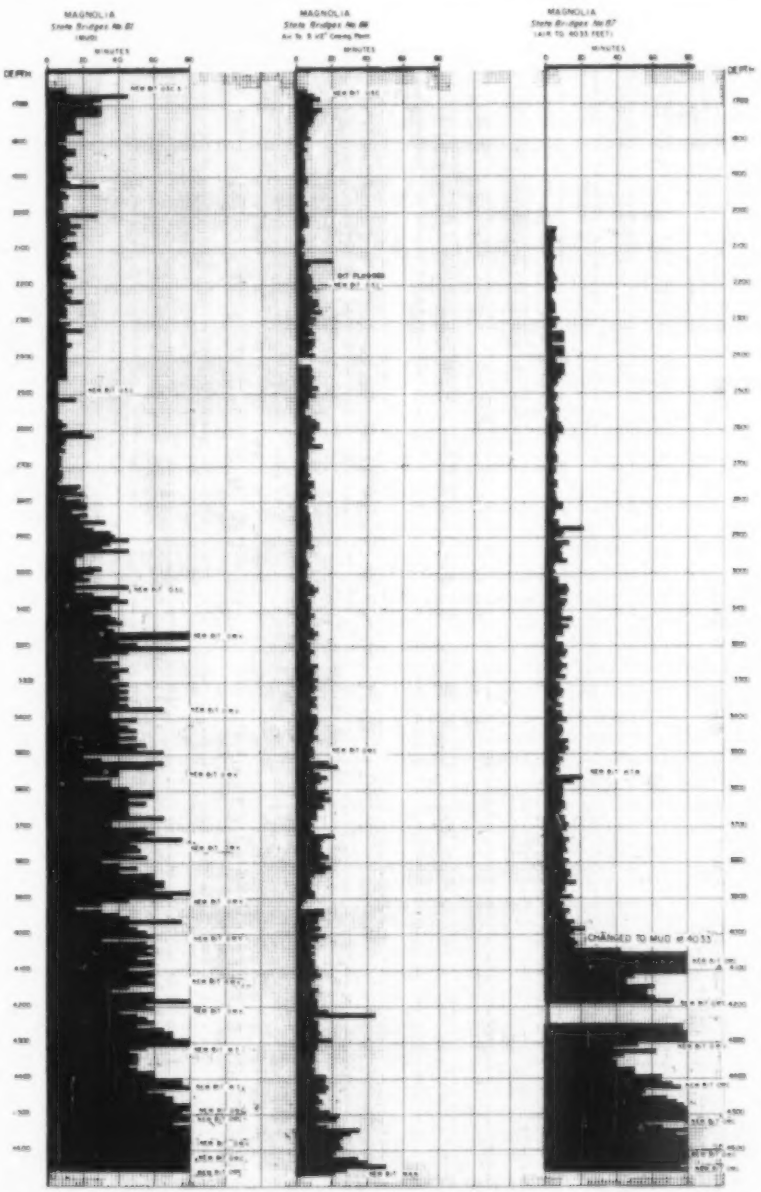


FIG. 4. **Drilling time comparisons** are made between mud drilled State Bridges No. 81, air drilled No. 86, and air and mud drilled No. 87

less rapidly than that well on which mud was used. When State Bridges No. 87 was mudded up at 4033 ft, the drilling rate decreased from approximately 1.5 minutes to in excess of 8 minutes per foot.

The total rotating hours plotted against depth, with bit changes indicated, is presented in Fig. 5.

The average penetration rate on those wells used for comparison was approximately 2.1 times as fast on those wells drilled with air in the depth interval 2000 to 3000 ft; approximately 4.0 times as fast in the depth interval 3000 to 4000 ft; and approximately 4.2 times as fast in the 4000 to 4500 ft depth interval. A complete breakdown is given in Table 2.

### Deviation

No deviation problem was encountered in drilling either State Bridges No. 86 or State Bridges No. 87. A comparison between the deviation on several wells drilled in this field is given in Fig. 6.

Deviation is not a problem in this field; however, those wells drilled with air had a tendency to remain more nearly vertical than those wells drilled with mud.

### Hole Characteristics

No hole problems were encountered in the drilling of the State Bridges No. 86, State Bridges No. 87 or the State Bridges No. 88.

Caliper logs and volume of cement necessary to cement the 5½-in. casing indicate that the hole remained closer to bit gage on those wells drilled with air than on those wells drilled with mud. Comparison of the caliper logs taken on State Bridges No. 81 and State Bridges No. 86 is shown in Fig. 7.

State Bridges No. 87 was partially drilled with mud so the erosional effects of mud were present throughout the drilling of the bottom 600 ft. It is felt that the results obtained on State Bridges No. 86 are more indicative of the results which may be expected from air drilling.

Table 3 shows a comparison of volumes of cement necessary. State Bridges No. 87 is not used in this comparison, even though it did indicate there were some savings in cement volume to be realized when a well is only partially drilled with air.

The average per cent fill of cement on those wells used for comparison was 27.7 per cent for mud and 73.5 per cent for air on State Bridges No. 86. State Bridges No. 87 indicated 45 per cent fill. Both wells on which air was used showed considerable better fill of cement even though State Bridges No. 87 was mudded up at 4033 ft.

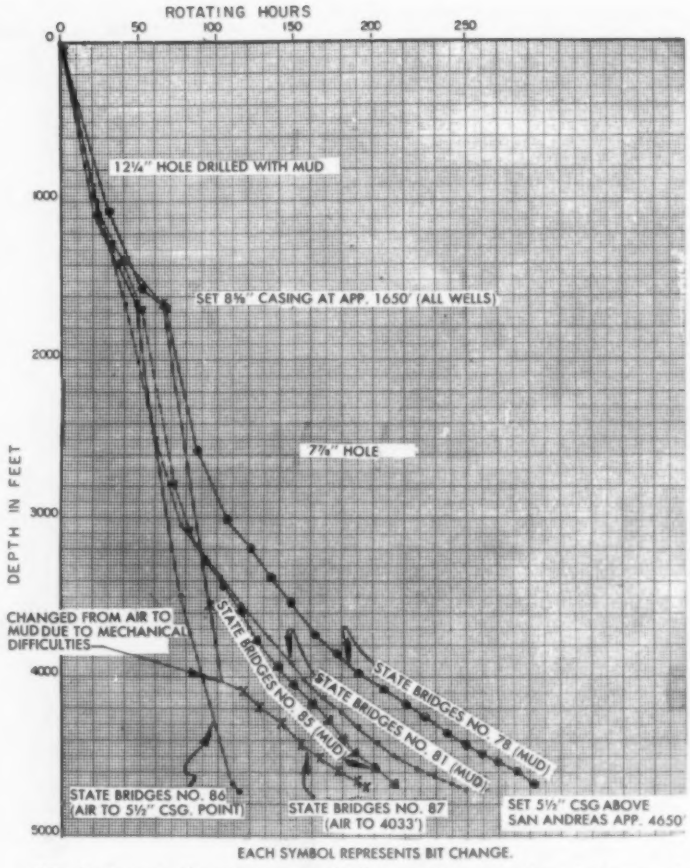


FIG. 5. **In rotating hours and bits used,** comparison between air and mud drilling is made. Air drilled No. 86 required only 114 rotating hours to a depth of about 4650 ft.

**TABLE 2—Penetration Rate, Mud vs Air Drilling**

MUD
Penetration Rate

| Depth Interval (Feet) | State Bridges #78 (Ft/Hr) | State Bridges #81 (Ft/Hr) | State Bridges #85 (Ft/Hr) |
|---|---|---|---|
| 2000—3000 | 31.3 | 27.0 | 45.5 |
| 3000—4000 | 11.2 | 12.8 | 15.6 |
| 4000—4500 | 4.5 | 4.9 | 6.9 |

AIR
Penetration Rate

| Depth Interval (Feet) | State Bridges #86 (Ft/Hr) | State Bridges #87 (Ft/Hr) |
|---|---|---|
| 2000—3000 | 62.5 | 62.5 |
| 3000—4000 | 45.5 | 58.8 |
| 4000—4500 | 22.7 | (5.4) (Mud) |

Average Penetration Rate

| Depth Interval (Feet) | Mud (Ft/Hr) | Air (Ft/Hr) |
|---|---|---|
| 2000—3000 | 30.3 | 62.5 |
| 3000—4000 | 13.2 | 52.2 |
| 4000—4500 | 5.4 | 22.7 |

**TABLE 3—Cement Volumes Used in Vacuum Field, New Mexico**

AIR AND MUD DRILLING

| Well Name & Number | 5½ inch csg. set at | Cmt. — amt. and additives | Vol. Cmt bbl | Fill to | % fill |
|---|---|---|---|---|---|
| MUD | | | | | |
| State Bridges #78 | 4675 | 1700sx 4% gel<br>100sx Neat | 491 | Circ. | 31.6 |
| State Bridges #81 | 4690 | 1700sx 4% gel<br>100sx Neat | 491 | 280 | 29.6 |
| State Bridges #82 | 4648 | 1665sx 4% gel<br>100sx Neat | 481 | 1970 | 18.2 |
| State Bridges #85 | 4675 | 1500sx 6% gel<br>200sx Neat<br>Average | 463 | 265 | 31.4<br>27.7 |
| AIR | | | | | |
| State Bridges #86 | 4691 | 1185sx Neat | 211 | Circ. | 73.5 |
| State Bridges #87 (Air to 4033') | 4695 | 500sx 4% gel<br>1000sx Neat | 338 | Circ. | 45.6 |

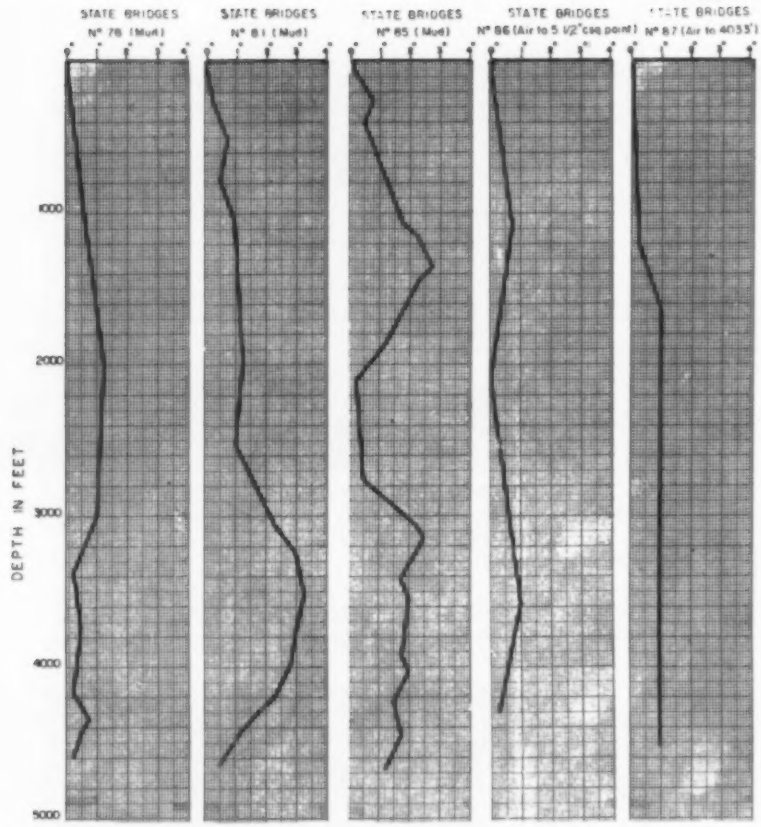


FIG. 6. **Well deviation** in air drilled wells No. 86 and 87 did not exceed one per cent, and although erratic, was not pronounced in mud drilled wells.

## General Economics

To arrive at a comparison of drilling operations where mud and air were used and to eliminate inequities due to rig management and operation, the following estimated data have been used:

| | |
|---|---|
| Rig Cost with mud (less bits) | $30.00 per hour |
| Rig Cost with air (less bits) | 50.00 per hour |
| Trip time per 1000 ft of depth | 0.80 hours |

In all cases prices of a major bit company have been used.

These estimates are thought to represent within a reasonable degree of accuracy the actual cost of these operations. The day rate cost of rigs, with drill pipe, in this area is approximately $700 per day and the cost of air equipment is approximately $450 per day. Trip time varies with the equipment, but 0.80 hours per 1000 ft of depth is thought to be a reasonable approximation of actual conditions.

The average total cost per foot for the interval between 8⅝-in. casing point and 5½-in. casing point was $3.39 per foot for those wells drilled with mud and $1.58 per foot for those wells drilled with air. This represents a cost reduction of $1.81 per foot. On State Bridges No. 87, the total cost per foot was $2.70 which represents a cost reduction of $0.69 per foot even though a large part of the benefit of air drilling was lost when the well was mudded up at 4033 ft. A complete economic comparison of the interval between 8⅝-in. casing point and 5½-in. casing point is given in Table 4.

Other savings are effected in addition to the drilling cost which contribute to an overall reduction in well cost. The most notable of these savings is that of drilling mud. The average mud cost in this area has been approximately $0.50 per foot. The use of air has resulted in a complete saving in mud cost which, for the average well, amounts to a savings of $2350.

The reduction of hole volume by the use of air has saved on the amount of cement necessary by approximately 500 sacks per well, which has resulted in an additional savings of approximately $500 per well.

## Practical Economics

Using mud, the following contract rates are in effect in the field:

| | |
|---|---|
| Footage | $ 3.75 |
| Day rate (without drill pipe) | 600.00 |
| Day rate (with drill pipe) | 650.00 |

The rates using gas are as follows:

| | |
|---|---|
| Footage | $ 3.00 |
| Day rate (without drill pipe) | 650.00 |
| Day rate (with drill pipe) | 700.00 |

Where air is used the contractor furnishes all equipment necessary to drill with air. In the event it is necessary to go to mud, the contractor goes on a day work basis. Magnolia furnishes bits on day work and contractor furnishes bits on footage.

Using the above rates and a 4700 ft well, the following comparison of cost of drilling to the 5½-in. casing point can be made.

| | Mud | Air |
|---|---|---|
| Footage | $17,625 | $14,100 |
| Cost of mud | 2,350 | — |
| Total cost | $19,975 | $14,100 |

This represents a net savings of $5875 in direct drilling cost or a savings of 29.4 per cent over the cost of drilling with mud. It may be possible to increase this saving as more experience is gained in the use of this technique.

In addition to the above direct drilling cost saving, approximately $500 in

**TABLE 4—Economic Comparison of Mud vs Air Drilling**

| Well Name and Number | Depth Interval From | To | Footage | Total Rot. Hrs. | Total Trip Hrs. | Total Time | Cost*@ $30.00 per hr. | Cost per foot $ | Bit cost per foot | Total cost per foot $ |
|---|---|---|---|---|---|---|---|---|---|---|
| MUD | | | | | | | | | | |
| State Bridges #78 | 1670 | 4675 | 3005 | 236.25 | 53.50 | 289.75 | 8693 | 2.89 | 0.85 | 3.74 |
| State Bridges #81 | 1651 | 4710 | 3059 | 218.75 | 57.60 | 276.35 | 8219 | 2.71 | 0.88 | 3.59 |
| State Bridges #85 | 1685 | 4675 | 2990 | 162.25 | 43.50 | 205.75 | 6173 | 2.06 | 0.70 | 2.76 |
| Average | | | 3018 | 205.75 | 51.53 | 257.30 | 7719* | 2.58* | 0.81* | 3.39* |
| AIR | | | | | | | Cost @ $50.00 per hr. | | | |
| State Bridges #86 | 1658 | 4961 | 3033 | 66.5 | 12.10 | 78.60 | 3930 | 1.30 | 0.20 | 1.50 |
| State Bridges #88 | 1710 | 4665 | 2955 | 73.25 | 13.70 | 86.95 | 4348 | 1.47 | 0.20 | 1.67 |
| Average | | | 3994 | 69.87 | 12.90 | 82.77 | 4139* | 1.38* | 0.20* | 1.58* |
| MUD AND AIR | | | | | | | | | | |
| States Bridges #87 | | | | | | | | | | |
| Air | 1660 | 4033 | 2373 | 67.5 | 6.20 | 73.70 | 3685 | 1.55 | 0.13 | 1.68 |
| Mud | 4033 | 4695 | 662 | 79.25 | 25.10 | 104.35 | 3131 | 4.73 | 1.59 | 6.32 |
| TOTAL | | | 3035 | 146.75 | 31.30 | 178.05 | 6816* | 2.25* | 0.45* | 2.70* |

*Weighted Average

COMPARISON BASED ON:
1. Rig cost with mud aid less bits $30.00 per hour
   Rig cost with air and less bits $50.00 per hour
3. Trip time of 0.80 hours per 1000 ft of depth
4. Hughes Tool Company bit prices.



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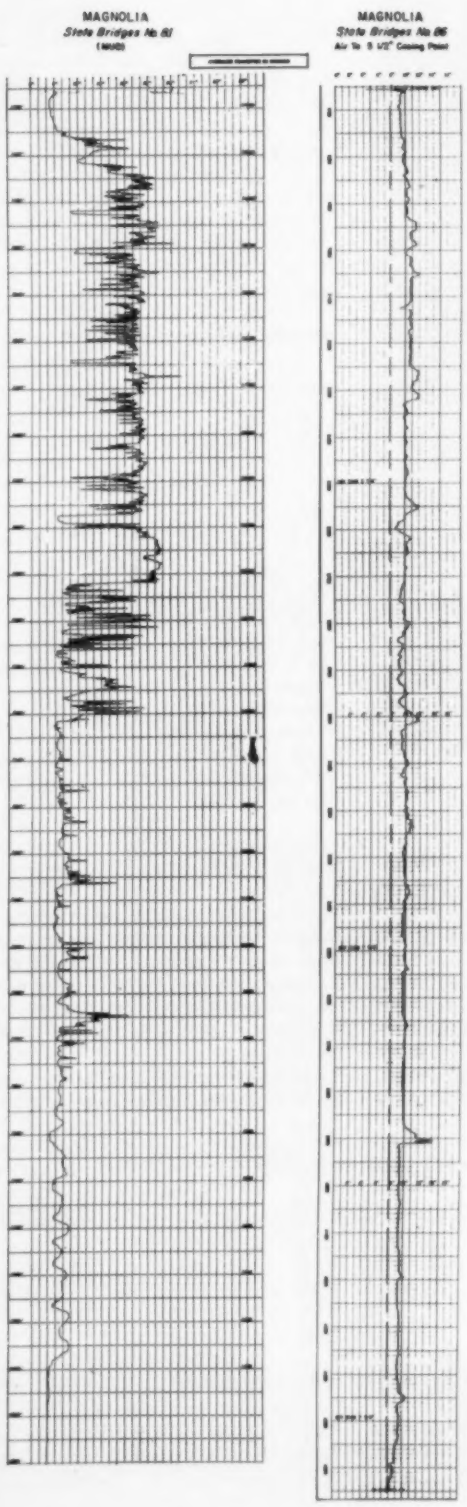



FIG. 7. **Hole diameter** proved to be more uniform in air drilled State Bridges No. 86, than in the mud drilled well No. 81.

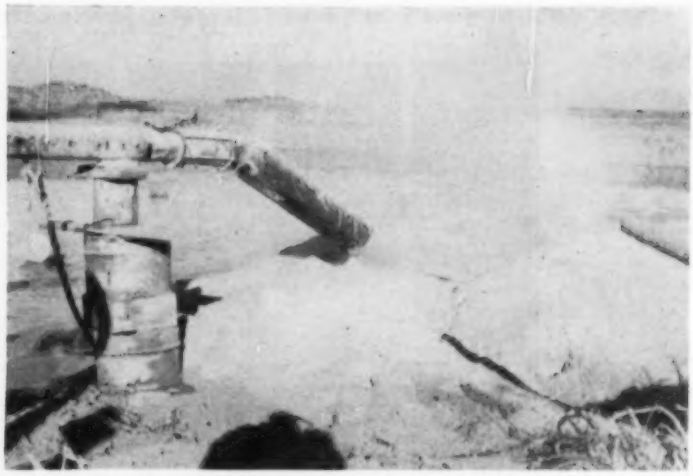
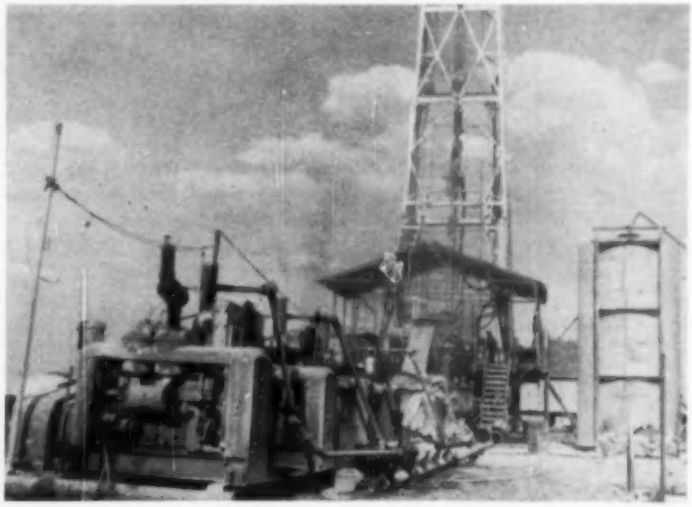


FIG. 8 **Sample testing** from cuttings blown to the surface was more difficult than analyzing mud cuttings, Magnolia found. Deposits at the end of the "blooie" line were dry, powder-like and fine.

FIG. 9. **Compressors,** only equipment not a regular part of the drilling rig, were leased from firms in the West Texas area.



cement cost was saved on State Bridges No. 86.

State Bridges No. 86 was drilled on a straight day work basis at $700 per day with the company furnishing bits, compressor equipment and circulating head. State Bridges No. 87 was mudded up at 4033 ft so the day rate was in effect during part of the drilling. State Bridges No. 88 was drilled on a straight contract footage basis.

Future operations in this field should determine an equitable contract price.

### Coring

General field practice calls for coring out from under the 5½-in. casing with a 4⅝-in. by 2¼-in. core head using oil. Some evidence of formation dam-

age has been noted. In an effort to reduce formation damage, State Bridges No. 87 was cored using air instead of oil.

The same hookup and compressors used for the air drilling operation were used for the air coring operation. Higher pressures and lower volumes were used. The standpipe pressure was approximately 260 psi at 600 cfm. Other techniques were the same as applied to coring with mud or oil.

An attempt was made to core State Bridges No. 88 with air; however, the core barrel was stuck after a short distance had been cored and it was necessary to circulate oil in order to free the core barrel.

No savings can be expected from coring with air in this area, actually the air coring operation will be more expensive than with oil; however, any cost occurring will probably be offset by a reduction in formation damage.

### Geological Considerations

Sample interpretation is more difficult where air is used as a circulating medium. The samples are fine and powdery; however, it is believed that most of the problems encountered can be overcome by improved sampling techniques, possible changes in drilling technique to satisfy geological considerations, and increased familiarity of the geological staff with this technique as this program is expanded.

Conventional electrical logging is not possible in the dry hole; however, all logs which do not depend on a conductive fluid being present in the hole can be run. This presents probably the most difficult geological problem at the present time.

Invasion of the hole by either oil, gas or water would be readily distinguished. The invasion of the hole by either oil or water in any quantity would necessitate mudding up while gas in small volumes would probably not create a hazard which could not be readily controlled.

It is believed that it would be impossible to pass up a potential pay while drilling with air.

### Conclusion

On the basis of data analysis compiled from the drilling of State Bridges No. 86, 87, 88, engineer recommended that all future wells in the Vacuum pool be drilled with air and that the company investigate other areas for possible use of air drilling. Magnolia engineers suggested that future drilling be used as a basis for determining an equitable contract rate for this type operation, and that feasibility of air coring operations be based on future drilling rather than on material gathered on the first test described in this article. ★

# Drilling Safety — An Operator Demands It!

**Producers can—and do—expect almost anything of a drilling contractor, and safety is at the head of the list. Here are six qualifications . . .**

**S. C. Oliphant,** *vice president*
*Tennessee Gas Transmission Company*

BEFORE any operator invites a contractor to bid for drilling a well, he should, and usually does, know something about the contractor, his employees, his equipment, financial stability, and past performance record.

The operator determines first if the contractor is a good contractor and if he will do a good job. Without safety practice, all other operations — regardless of how well performed — are liable to failure. A contractor who does not stack up to these qualifications probably will not be invited to bid.

Here are six safety demands. How do you stack up?

1. **Safety consciousness** on the part of the drilling crews and tool pushers. Someone once said, "If I am **always** thinking of safety, I can't get all this work done." It might be stated that if he is not thinking of safety, he may never have a chance to get all the work done. It is not intended by this (always) that a person should not do the normal drilling jobs, but that he do them in a manner in keeping with safety practices.

2. **Adequate job knowledge** of all personnel. I know that everyone must start somewhere. When we start on a job, we are "green horns," "boll weevils," etc., and it is in this state of job performance that safety is of greatest importance. The first training of new personnel is a field in its own. It can be done safely, has been done safely, and is being done safely.

3. **Adequate job supervision.** Even after new personnel have been adequately trained, it is still necessary to provide proper and adequate supervision. The best machinery is of no use if it is not properly operated. In order to properly operate the drilling machinery, it is imperative that good supervision be provided. This is as important a safety factor as any of the equipment which can be made available for fire fighting, and blowdown control.

4. **Suitable equipment** for the job involved. "Never send a boy to do a man's job." An operator expects a contractor to provide ample equipment so that it will not be a strain or constitute a safety hazard. Equipment that is worn out, too small, or just haywire, creates a hazard to everyone around the job, both employees of contractor and operator. It is also a hazard to the pocketbook. Loss of time and failure of equipment result in loss of dollars required to complete the job. We hesitate to associate dollars with loss of life and limb, but we cannot divorce dollars from safety. Safe operations are cheap operations. When adequate equipment is spoken of, this includes blowdown preventers, choke manifolds, fire-fighting equipment, first aid equipment, etc.

5. **Good housekeeping.** This factor can be one of the most important safety factors. A sloppy housekeeper does a sloppy job. A good housekeeper does a good job and as a whole the cheapest job. A muddy rig floor, muddy walkway, disarranged tools and equipment are all safety hazards. An operator demands good housekeeping to protect his own personnel, and the contractor should demand good housekeeping of his personnel to protect his own investment and operation.

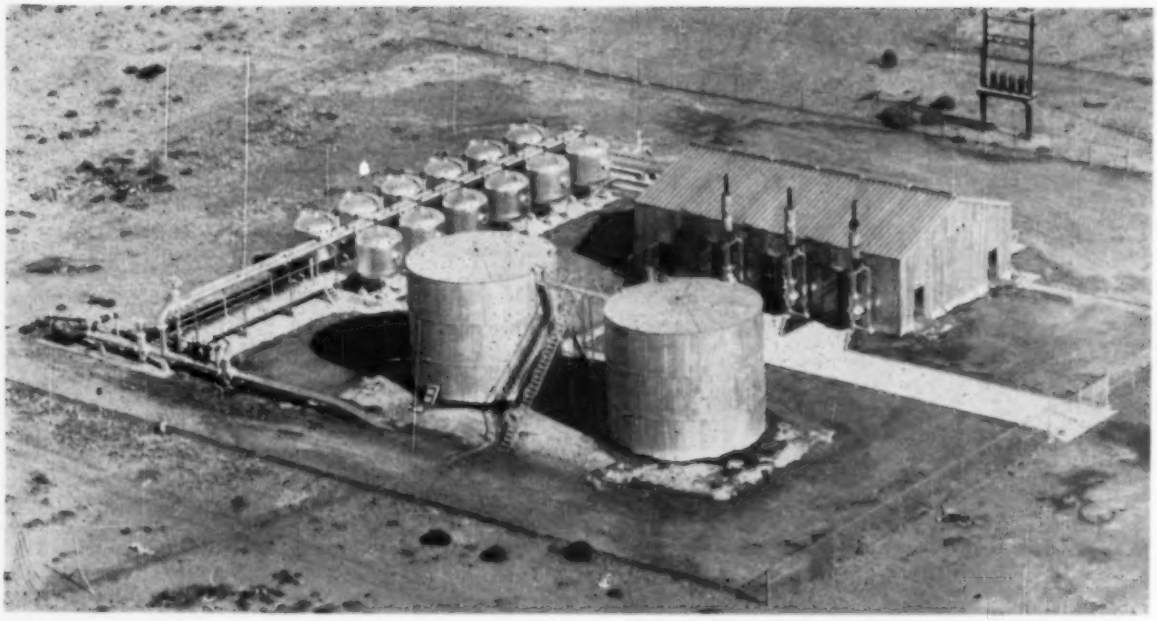
6. **Safety guards.** This goes along with good housekeeping. The contractor should provide adequate handrails on walkways, chain guards, and eliminate exposed electrical connections and headache hazards. Most of the accidents around drilling rigs are attributed to lack of safety guards and poor housekeeping.

### Postscript — to the Operator

Safety operations around a drilling rig are not a one-way program. The operator and contractor must work together on this safety program. Time should be set aside for periodic safety meetings. Time should be set aside to test blowout and related equipment for safety purposes.

### Acknowledgment

Excerpts from "What Should the Operator Expect of a Drilling Contractor's Safety Program," presented by Oliphant at eleventh annual Drilling Industry Safety Clinic, sponsored by the American Association of Oilwell Drilling Contractors, Dallas, Texas, November 8-9, 1956.



**Water pump station** and filtration plant of the Goldsmith San Andres Unit in the Goldsmith field of Ector County, Texas. Water enters station at lower left, passes through filter bank and into pump suctions. Two 3000-bbl tanks in foreground care for backwash water.

**Water reacts favorably in the San Andres dolomite . . .**

# PRESSURE MAINTENANCE

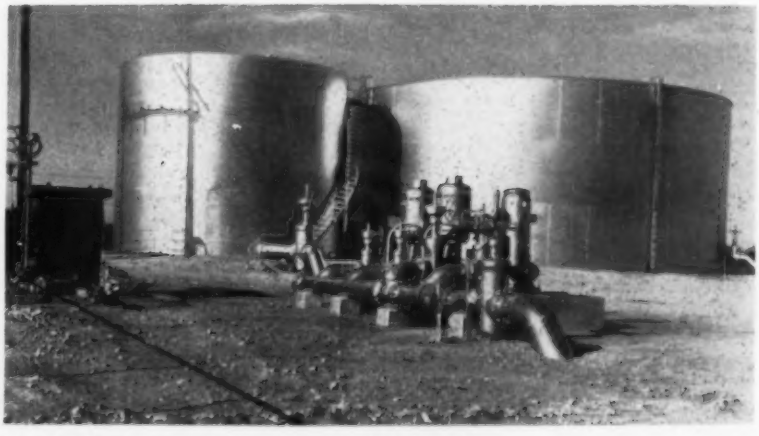
## In the Goldsmith Field

Gulf Oil's peripheral water injection project meets with success in this West Texas field. Gas injected into gas cap

OVER 36,000,000 bbl of water have been injected in the Goldsmith San Andres unit. By injecting water below the oil-water contact and gas in the gas cap, Gulf Oil Corporation, unit operator, is maintaining the reservoir pressure. Gulf expects to increase oil recovery substantially above that which could be anticipated by primary operations.

**Location.** The Goldsmith field is located in the northwestern portion of Ector County, Texas, immediately west of the town of Goldsmith, approximately 15 miles to the northwest of Odessa.

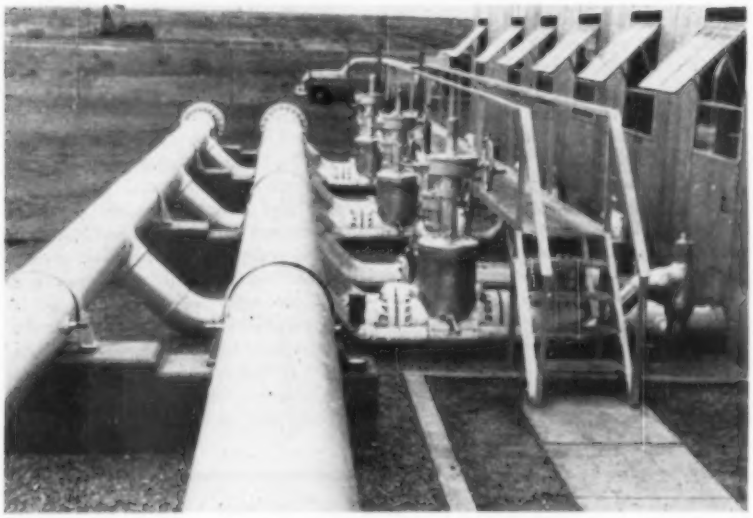
**History.** The field was discovered in 1934 and although it is difficult to credit any particular well with the discovery, such credit probably should be given to the Landreth Production Corporation's Scharbauer 1 which was completed in the northeast part of the field in December, 1934, as a gas well. The first producing oil well in the field was Landreth's Scharbauer A-1, also located in the northeastern portion of



**Hendrick pump station** (between Wink and Kermit, Texas) pumps 60,000 bbl of water daily through 31 miles of 18-in. line to Goldsmith field.

**Bank of 12 rapid sand filters** clean salt water going to pump suction manifold.

**Salt water suction manifold** at right feeds water to three pumps which discharge some 60,000 bbl daily through discharge manifold at left.



the field. In May, 1935, Gulf's Goldsmith 1 was completed as an oil producer. This well was the first producer to be completed in the South Dome of this field.

**Development.** Development of the northern, or non-unitized, part of the field was rapid during the years 1937 and 1938, and by that time sufficient knowledge existed to indicate that the Goldsmith field contained a substantial oil reserve. Intensive drilling operations took place in the southern, or unitized, part of the field during 1938, 1939, and 1940 on Gulf Oil Corporation and jointly-owned Phillips Petroleum Company and Pure Oil Company properties. The rapid development of the field is indicated by the fact that approximately 860 wells were completed during the years 1937 to 1940, inclusive. Development of the non-unitized area was essentially complete by the end of 1940 when about 460 oil wells had been drilled in that area. By that time 426 wells had been completed in the unit area. Productive area for the field is estimated to be 30,700 acres of which 14,100 acres are considered to be in the unit area. As of October, 1956, there were 531 producing wells in the unit area, giving an average density of about 26.6 acres per well for that area. The well spacing in the oil productive portion of the South Dome is 20 acres.

**Completion practices and workovers.** Many of the early wells in the field were drilled with cable tools; however, rotary tools were employed on a majority of wells. The casing program for most wells in the field consists of from 180 to 250 ft of 10¾-in. or 13-in. surface pipe and 5½-in. or 7 in. oil string set in the vicinity of the original gas-oil contact. Some wells were cased to bottom and gun perforated opposite the producing section. The usual practice was to acidize on completion although shots of nitroglycerine were used on some wells. Proper completion techniques have generally resulted in favorable well behavior. The early practice of setting casing very near or even above the gas-oil contact has resulted in a rather large number of high gas-oil ratio wells. Later practice was to case off the gas cap and on those wells, lower gas-oil ratios were obtained.

**Workovers** in the field have been conducted primarily to decrease gas or water production with a majority of this work being designed to reduce excessive gas production. Most workovers involved squeeze cementing or packer installation and a substantial majority of these were considered at least to some degree successful. The overall result of the field-wide workovers has been conservation of considerable quantities of gas.

**Goldsmith field geology.** The reservoir occurs in the San Andres formation of lower Permian Age located on the east side of the Central Basin Platform. The San Andres is a gray to tan medium crystalline anhydritic and slightly oolitic dolomite with granular, fossil cast and vuggy porosity. The entire field is composed of two large anticlinal domes extending in a northwest-southeast direction and separated by a saddle. The formation dips about 100 to 150 ft per mile and occurs at a depth of about 4200 ft. Two large gas caps overlie the oil accumulation, one in each of the two domes, and the total volume of gas caps represent about one-half of the oil zone volume.

**Original gas-oil and water-oil contacts** varied somewhat in depth and occurred at about 985 ft subsea and 1075 ft subsea respectively. Porosity averages about 10.2 per cent, permeability about 24 md horizontal to the bedding planes, and connate water saturation about 14.3 per cent of pore volumes.

**Reservoir fluid characteristics.** The existence of gas caps in the field point to the conclusion that the reservoir oil was originally saturated with gas. Saturation pressure for the oil at the reservoir temperature of 94F was 1712 psig. Original dissolved gas-oil ratio was 757 cu ft per bbl of stock tank oil. Reservoir oil viscosity ranges from about 0.91 centipoise at original reservoir conditions of pressure and temperature to about 2.13 centipoises at 50 psi and reservoir temperature. Formation volume factor of the original oil was 1.360 bbl of reservoir oil per barrel of stock tank oil. Produced oil gravity ranges from about 35 to 38 deg API and hydrogen sulfide content of the produced gas is approximately 1800 grains per 100 cu ft of gas.

**Reservoir performance-primary.** Primary production operations in the unitized area cover a period from initial discovery until March, 1951, when gas injection operations were initiated in the South Dome gas cap area.

**Primary pressure performance.** Pressure decline in the unitized area was practically linear with production throughout the entire primary production period. By March, 1951, about 62,000,000 bbl of stock tank oil had been produced from the area, and reservoir pressure had declined from 1712 psig to about 1130 psig.

**Primary gas-oil ratio performance.** Gas-oil ratios of wells in the unit area during the period of primary production were in general fairly stable. Relatively few wells produced at excessive ratios due to employment of proper completion techniques and workovers. The average produced gas-oil ratio for the unit area increased gradually from less than 1000 cu ft per bbl in 1939 to slightly less than 3000 cu ft per bbl in 1951.

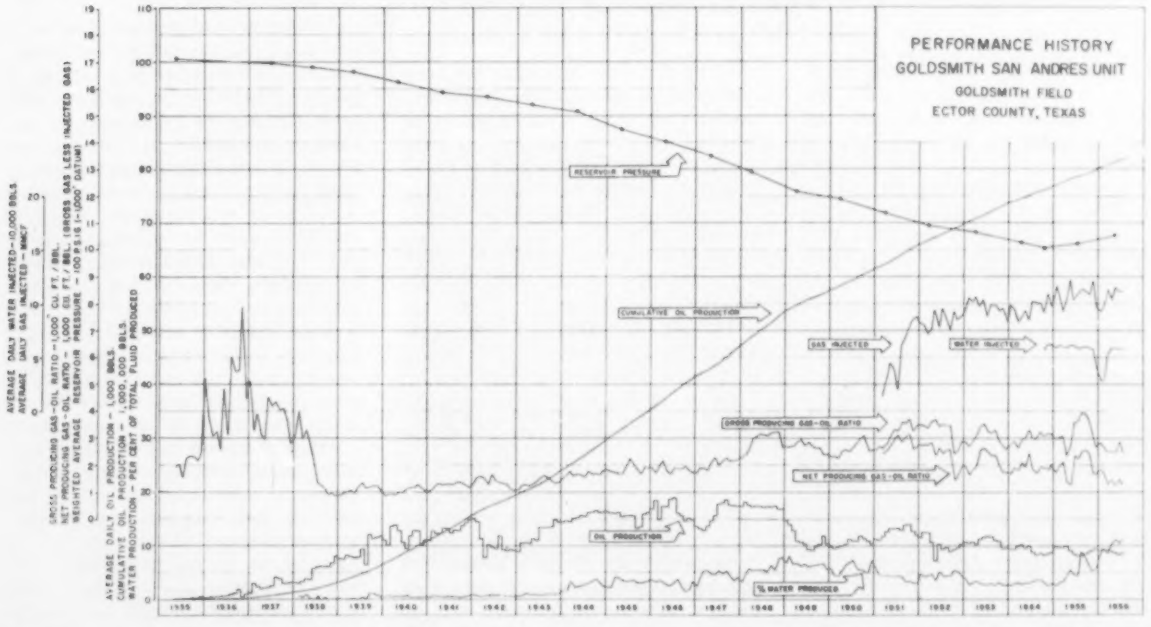
**Primary water production.** Very little water was produced from wells in the unit area during the primary production period. Water production increased slowly from negligible amounts to about 5 or 6 per cent of the total produced fluid in 1951.

**Type primary reservoir performance.** Reservoir pressure, gas-oil ratio, and water production information along with other performance characteristics point to the conclusion that the primary reservoir producing mechanism was a combination gas-cap and solution gas drive. Well performance information indicated that water encroachment into the reservoir was negligible and that while an oil-water level exists in the reservoir, the surrounding aquifer lacks sufficient volume or continuity or both to contribute materially to the reservoir producing mechanism. Early recognition of the fact that free gas in this area contributed substantially to primary reservoir energy has led to conservation of this energy and hence to more efficient production of oil in the unitized area.

**Unitization.** On October 1, 1952, an area covering the Goldsmith South Dome as well as the southernmost four sections of the North Dome were unitized and Gulf Oil Corporation became unit operator. Unitization was accomplished for the purpose of inaugurating a pressure maintenance project. Reservoir pressure is being maintained by the injection of water below the oil-water contact on the periphery of the field. Gas is also being injected in the South Dome cap at a rate sufficient to prevent shrinkage of the cap. The unit covers about 18,240 acres of which 14,100 are estimated to be productive.

**Gas injection.** Gas injection was actually commenced in March, 1951, some 18 months before the unit went into effect. Since unitization, an average of about 10,000,000 cu ft of gas per day has been injected into the gas cap through four wells. Residue gas from the Phillips Goldsmith plant is being injected against a back pressure at the wellhead of about 1100 psig.

**Water injection system.** Water injection was started on October 18, 1954, at a rate of 60,000 bbl per day and approximately 36,000,000 bbl had been injected into the unit area by August 1, 1956. Water is injected into 31 wells forming approximately two concentric rings around the South Dome and about 2000 bbl of water per well per day are being injected below the water-oil contact. The project required the deepening and conversion of 21 oil wells and the drilling of 10 wells especially for water injection. Injection wells are completed with pipe set 25 ft below the oil-water contact with approximately 275 ft of formation exposed in open hole below that


PERFORMANCE HISTORY
GOLDSMITH SAN ANDRES UNIT
GOLDSMITH FIELD
ECTOR COUNTY, TEXAS
RESERVOIR PRESSURE
CUMULATIVE OIL PRODUCTION
GAS INJECTED
WATER INJECTED
GROSS PRODUCING GAS-OIL RATIO
NET PRODUCING GAS-OIL RATIO
OIL PRODUCTION
% WATER PRODUCED
AVERAGE DAILY WATER INJECTED - 10,000 BBLS.
AVERAGE DAILY GAS INJECTED - MMCF
GROSS PRODUCING GAS-OIL RATIO - 1,000 CU FT./BBL.
NET PRODUCING GAS-OIL RATIO - 1,000 CU FT./BBL. (GROSS GAS LESS INJECTED GAS)
WEIGHTED AVERAGE RESERVOIR PRESSURE - 100 PSIG (-1,000 DATUM)
AVERAGE DAILY OIL PRODUCTION - 1,000 BBLS.
CUMULATIVE OIL PRODUCTION - 1,000,000 BBLS.
WATER PRODUCTION - PER CENT OF TOTAL FLUID PRODUCED

point. Average wellhead injection pressure was 533 psig as of July, 1956.

**Source of water.** A suitable supply of water was not obtainable from the Goldsmith field area, however, a water source was obtained from the Hendrick Reef near Wink, Texas. A sufficient quantity of water is obtained from five water supply wells drilled to a depth of approximately 3600 ft.

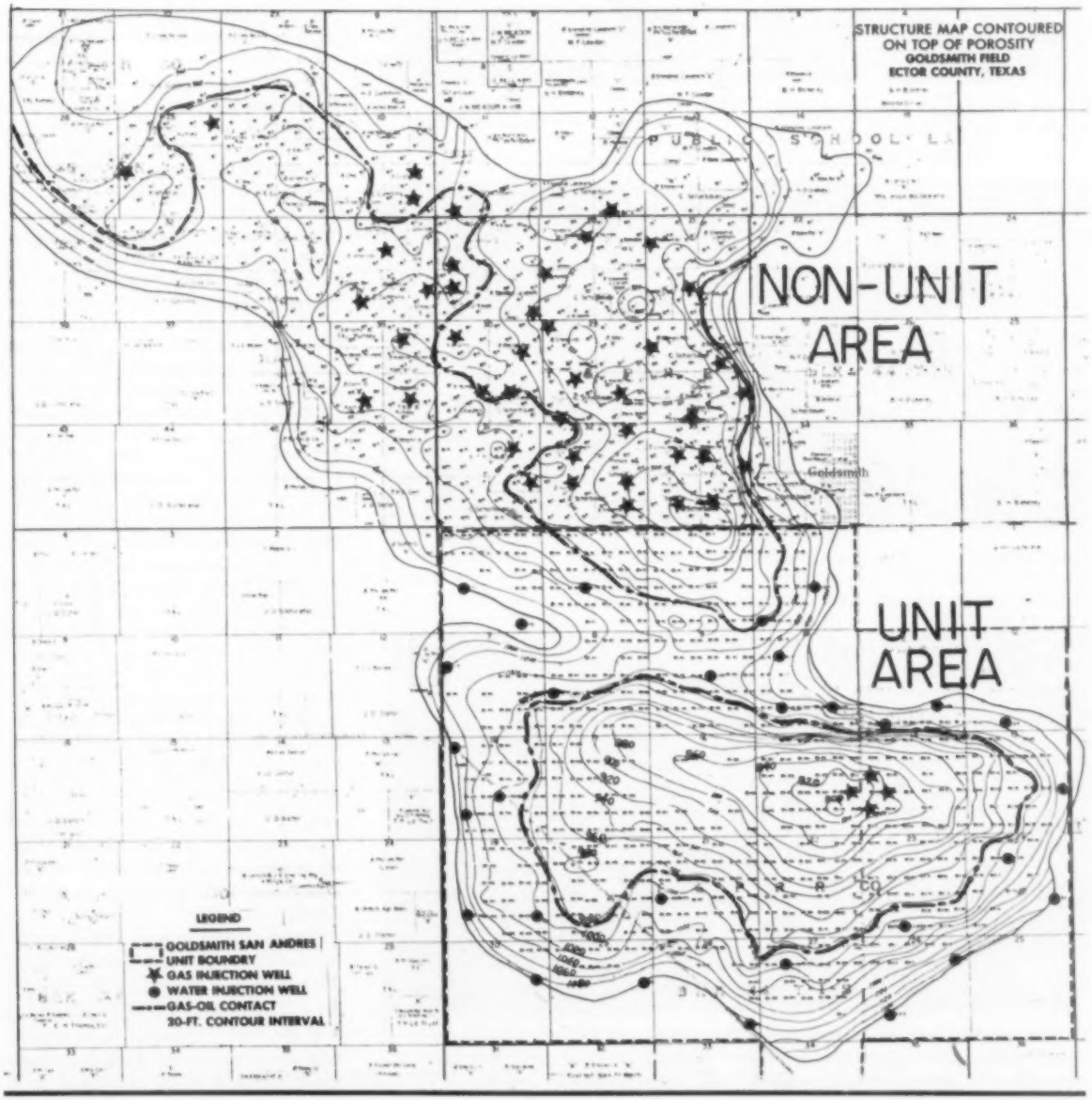
Water is produced by turbine pumps into nearby storage facilities from where it is pumped 31 miles through an 18-in. pipe line to the Goldsmith station. This station (shown in illustration) consists of 12 rapid sand filters, two 3000-bbl back wash tanks and three vertical quintuplex plunger pumps driven by three gas engines rated at 544 bhp each. From the Goldsmith field station the water is transmitted through about 28 miles of high pressure distribution lines, varying in size from 3 to 12-in. diameter, to the injection wells. The water supply system is designed for automatic operation.

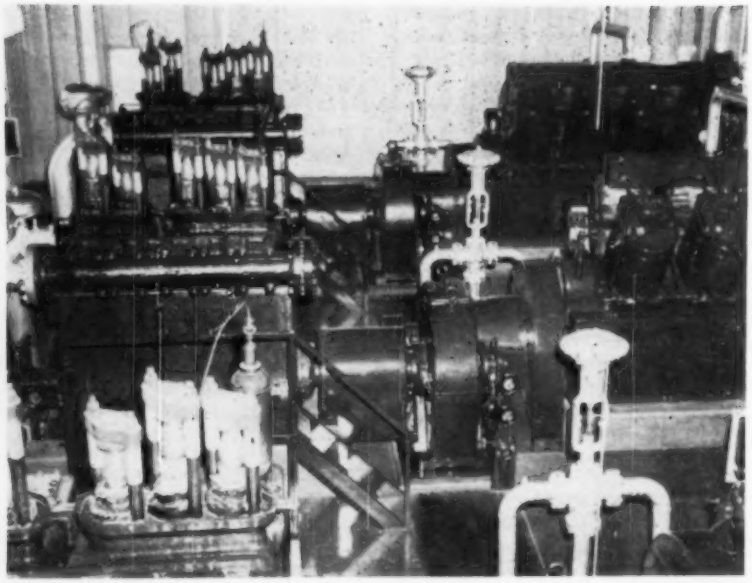
**Water treatment.** A water-soluble absorptive-type inhibitor is being used in the system to prevent corrosion to water producing, transmission, and injection equipment.

## Results Obtained from the Pressure Maintenance Project

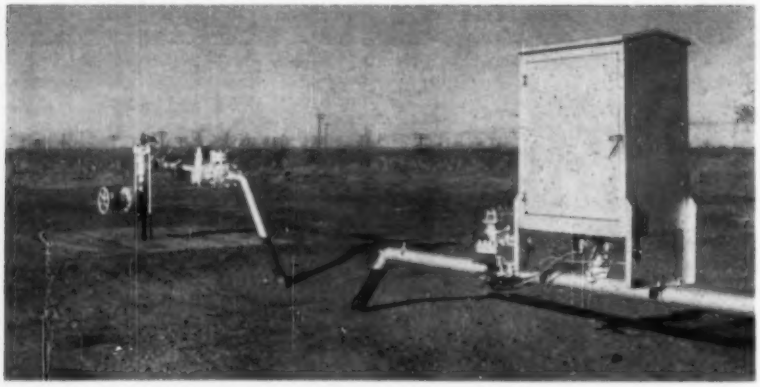
The Goldsmith San Andres unit has been divided for proration purposes into the North Area and South Area. The North Area comprises the two rows of wells along the north line of the unit. The wells in the North Area have been operated, with regard to allowable, in the same manner as the wells of other operators in the non-unitized portion of the field. The South Area comprises the balance of the unit.

Transfer of allowables within the South Area of the unit has permitted flexibility of operation and the production of the most efficient wells. As a result of this and the injection of water and gas into the reservoir, it has been possible to continuously produce the maximum oil allowable permitted while maintaining the net gas production from the South Area of the unit considerably below the limiting 2000

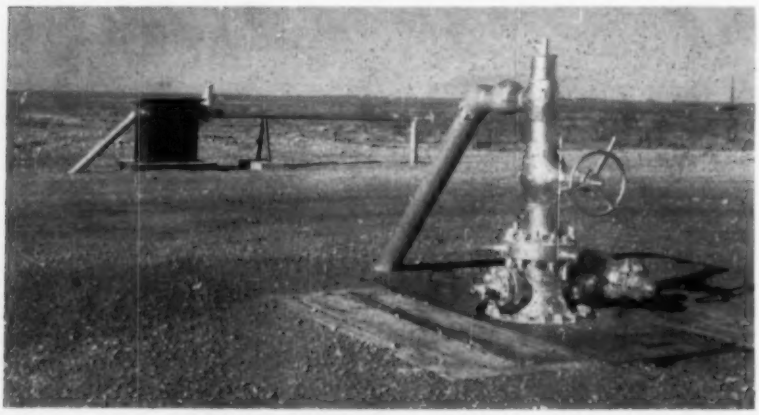




**Three 5-plunger pumps** at left inside pump station are driven by three 544-hp gas engines at right.



**Gas injection well** in the Goldsmith San Andres unit. Four such gas injection wells inject a total of about 10,000,000 cu ft daily into the San Andres formation gas cap.



**Typical water injection well** of the Goldsmith San Andres unit peripheral injection system. There are 31 water injection wells in this unit.

to 1 ratio. Total cumulative oil production from the unit area as of August 1, 1956, was about 82,000,000 stock tank barrels, some 13,000,000 bbl having been produced since the date of unitization.

Water production from the unit area has never exceeded 12 per cent of the total fluid produced, and since the date of unitization, has averaged only 4.9 per cent.

Subsequent to unitization, approximately 14 billion cubic feet of gas and 36,000,000 bbl of water have been injected into the reservoir. As a result of the unitized project, an upward trend of GOR's has been eliminated and the average gross producing GOR subsequent to the date of unitization has been 2983 cu ft per bbl. In addition, the net producing gas-oil ratio has been reduced from an average of 2652 cu ft per bbl for the nine-month period prior to unitization to 1924 cu ft per bbl since the date the unit was formed.

The most gratifying results obtained from the project to date have been the favorable change in reservoir pressure performance throughout the unit. The weighted average reservoir pressure for the unit area had been declining at an average rate of 46 psi per year prior to water injection; whereas, a reversal of pressure change has occurred and the average reservoir pressure has increased from 1007 psig at the date of initial water injection to 1051 psig as of May 9, 1956. This is a pressure increase of 46 psi for the first 19 months of operation of the water injection program.

The pressure throughout the unit area has not been completely equalized; however, there is evidence that it has been maintained, or favorably influenced, throughout the entire unit.

As a result of Texas Railroad Commission hearings on January 5 and May 21, 1956, the Commission approved a voidage replacement formula for the Goldsmith field. The voidage replacement formula provides for allowable credit to be received for fluids injected as long as the fluids injected equal fluids produced so that no net reservoir voidage will occur and pressure will be maintained. Because of the successful pressure maintenance program, the unit has been operating under this formula since August 1, 1956.

The project has been very successful to date and has resulted in a change in the producing mechanism for this area from a combination solution gas and gas cap drive to a pressure maintenance operation through the injection of water and gas. ★ ★ ★

# Effect of Modern DRILLING TECHNOLOGY On Well Cost

**Well costs have been kept at 1950 levels — thanks to technological improvements made in the drilling industry. Annual research expenditures, now estimated at $12,500,000, must be stepped up to meet many new and existing problems**

**Douglas Ragland**
*Chief Petroleum Engineer, Humble Oil & Refining Company, Houston, Texas*

AN appraisal of the performance of the drilling industry in the United States shows that, although there has been a substantial increase in basic cost items, well costs in the last five-year period have been maintained at approximately 1950 levels. This improvement in drilling efficiency has resulted primarily from the effect to technological improvements brought about by basic research in drilling.

With an increasing ratio of annual well cost to gross income for the domestic oil-producing industry, the question of technical improvement becomes a vital consideration.

Drilling research represents an extremely small item in the drilling and producing industry's budget. In consideration of the outstanding results obtained from the research performed to date, and in view of a long and impressive list of problems that deserve research attention, the advisability of expanded effort is clearly indicated.

Well cost, or the annual expenditure that is made to drill and complete new wells, is the principal capital outlay of the domestic petroleum industry. In fact, the more than $3 billion invested in new U. S. wells in 1955 represents over 40 per cent of the market value of the crude-oil and gas production for that year. In view of the trend toward deeper and costlier wells, indications are that this ratio of expenditure to income will increase unless the industry can find ways to decrease unit costs and drill fewer unnecessary development wells. It is apparent that the question of technical improvement, the chief cost-control weapon of any industry, is a vital one to petroleum. This report is intended to show the effect of technology on well cost and to measure in broad terms the adequacy of research and development in the fields of well drilling and completion during the past 5 to 10 years. Final attention will be directed to areas where new or additional research might be attempted.

Total industry expenditures for drilling research and development can only be guessed at. A limited sampling of tool and equipment manufacturers, drilling contractors, and oil operators places the domestic industry figure in the range of $12,500,000 invested in drilling research and development of all types during the year 1955. Of this amount, $2,500,000 went to pay for offshore projects, which, because of their highly specialized nature, should probably be considered apart from the general field of drilling research. If this is done, then the industry figure for 1955 becomes $10,000,000 for general drilling research and development. This represents about 1/3 of 1 per cent of the $3 billion gross business handled by the industry for that year, and it is believed this ratio of research expenditure to total expenditure has remained about constant for the past several years.

Regardless of the accuracy of these guesses, the question of whether the industry's research and development effort is adequate cannot be answered directly. A. W. Thompson, API vice president for production, has long been concerned that the drilling contractor, at least, is spending too little on research, although he has not commented on the overall industry record. A recent report on industrial research indicates that a wide range of industries is spending from "less than 1 per cent to more than 6 per cent" of sales on research. On this basis, 1 per cent of gross business would seem to be on the low side. For the drilling industry, an "acceptable minimum" of 1 per cent of gross business would amount to about $30,000,000 annually at current levels of activity, or about three times $10,000,000 per year, which we guess to be the amount now being spent. Regardless of inter-industry comparisons, however, a more convincing test of adequacy is an appraisal of tangible results in terms of technical advancements and cost reductions.

### Technological Improvements

Although the drilling research and development program has failed, during the last decade at least, to produce any single revolutionary or radical improvement, it has contributed an increasing stream of lesser but significant developments. A listing and brief description of some of the more important of these seem worthwhile here.

**Jet hydraulics.** Large increases in drilling rates have been made possible as the result of extensive research in the field of drilling hydraulics. Knowledge derived from this work has led to the development of "jet-drilling technology," or the effective application of increased bit weights made possible by the correct utilization of high-velocity jet streams at the bit head for efficient cutting removal. It has provided the driller, for the first time, with a sound technical basis for sizing the rig hydraulic components. As an example of this development (Fig. 1), a well drilled in 1952 in South Louisiana with only 50 to 160 hydraulic horsepower available at the bit required 120 days to reach a depth of 17,000 ft. In 1955, a nearby completion utilizing 200 to 700 hydraulic horsepower at the bit required only 50 days to reach a depth of 16,906 ft, for a reduction of 57½ per cent in drilling time. In drilling the two wells, comparable mud, bits, drill pipe, hole sizes, hoisting equipment, and casing programs were used, except the bits for the more recent well were equipped with proper jets to utilize the full advantages of the increased power of the hydraulic system.

Based on a paper by the same title presented before the American Petroleum Institute, Division of Production, Chicago, Illinois, November 14, 1956.

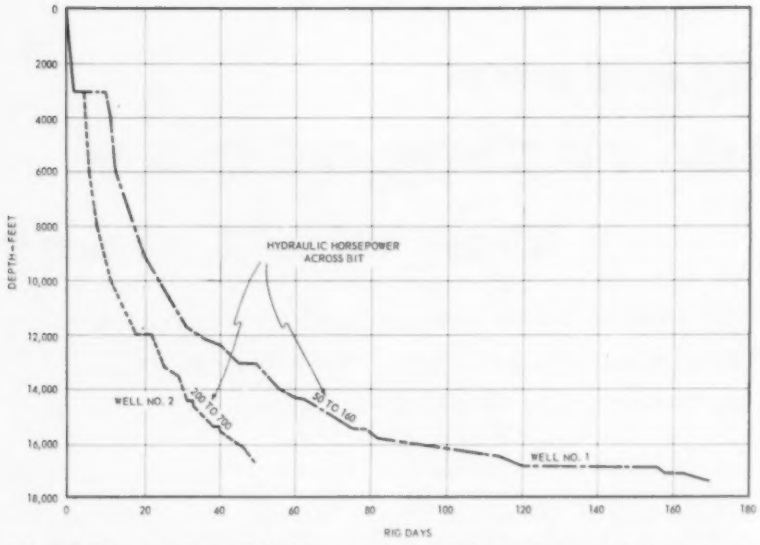



FIG. 1. **Drilling rates in South Louisiana** were trimmed almost 400 per cent by increasing the hydraulic horsepower across the bit. Mud, bits, drill pipe, hole sizes, hoisting equipment, and casing program were similar in Wells No. 1 and No. 2.

**Chert bits.** Exhaustive laboratory and field investigations have provided a better understanding of the mechanics of chip generation by rolling cutter-type bits — knowledge that has led to highly significant improvements in the tooth designs of both hard-and-soft-formation bits. Out of this research came the radically new tooth which is not a tooth at all, but is a rounded button of tungsten carbide imbedded in a smooth roller. In spite of its harmless appearance, this new design proved far superior to any other for certain extremely hard formations, and it quickly became known as the "chert bit." Prior to its development, a typical 106 ft section of chert in the Yarbrough and Allen field, Ector County, Texas, required 20 conventional hard-formation bits and 74¼ hours rotating time to drill. A single "chert bit" now drills the same section in 26 hours and saves 19 round trips with the drill pipe! In all, drilling cost for this difficult formation has been reduced from $143 per ft to about $25 per ft.

**Diamond drilling.** Other important bit research work has centered around diamond drilling and core bits. The usefulness of these formerly limited-application tools has been extended by virture of the development of more erosion-resistant matrix material for holding the diamond cutting elements, improved fluid-discharge patterns at the bit head, and the adoption of advanced drilling techniques involving appreciably increased drilling weights and rates of circulation. A recent application of these improved drilling tools in a deep well drilled in the Southwest Texas area (Armstrong field, Kenedy County) permitted an estimated 50 per cent reduction in drilling time for medium-hard but highly abrasive formations encountered at 11,000 to 16,000 ft. The saving amounted to forty-five 24-hr days of drilling time. Table 1 summarizes the experiences in other areas of Southwest Texas where diamond drill bits have been unusually effective in drilling Frio and Vicksburg formations. The 15 diamond drill bits listed averaged 1096 ft per bit and saved an estimated $9400 each in overall drilling cost. This saving is not attributed to any exceptionally high drilling rate, but to the long bit life obtained and the consequent reduction in trip time to change bits. Use of the diamond drill bit in its present form is limited primarily to abrasive and non-friable formations, inasmuch as the small size of the cuttings produced by the diamonds does not permit the diamond drill to compete with the rolling cutter-type rock bit in most formations. Where it is desired to core the formation rather than drill it, however, the diamond core bit has gained practically universal acceptance because of the higher percentage recovery and the larger-diameter core which it obtains.

**Mud properties.** Many laboratories engage in limited amounts of research on drilling-fluid (mud) properties, and this work has been essential to the development of modern rotary drilling technique. During the past few years, oil-emulsion muds have been perfected to combat sloughing formations and increase drilling rates. Also, the use of low-density mud, or the substitution of water for mud to increase drilling rates, has come into widespread use, particularly in hard-formation areas. Use of water as a drilling fluid, where formation pressures permit, has long been known to increase rate of penetration over those attained with higher-density muds; but not until the advent of recent advanced hydraulic practices has it been possible to drill with water through certain formations in the West Texas area with sufficient speed to prevent sloughing. Scores of West Texas rigs are now setting new drilling records using essentially water as a drilling fluid.

**Air and gas drilling.** Recent development work to take ultimate advantage of low-density drilling mud has produced techniques for using aerated mud and even straight air or natural gas as rotary drilling "fluid." Where low-pressure formations free of water flow are to be penetrated, phenomenal drilling speeds can be attained with the straight air or gas. For example, drilling speed was increased over 600 per cent in a Southwest Texas well when gas was substituted for drilling mud (Table 2)! In addition to the greater drilling speed, footage per bit was also increased substantially. Comparative drilling-time curves for several other wells drilled with gas in the same area are shown in Fig. 2, plotted alongside curves on nearby wells drilled with mud. With the tremendous speed advantage offered by the new technique, it is not surprising that air or gas drilling is spreading rapidly to all drilling

**TABLE 1—Comparison of Drilling Results Using Diamond Bits and Roller Type Bits—Frio and Vicksburg Formations, Southwest Texas.**

| Area | Interval — Feet | | Footage Drilled | Bit Size-In. | Number Of Bits | | Footage Per Bit | | Estimated Savings | |
|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | Diamond | Roller* | Diamond | Roller* | Rig Days | Well Cost |
| Armstrong Ranch, Kenedy County | 10,000 | 16,000 | 9,045 | 6 and 6⅜ | 10 | 139 | 904 | 65 | 54.0 | $108,000 |
| Kohler Ranch, Duval County | 8,928 | 10,927 | 1,764 | 6 | 1 | 30 | 1,764 | 59 | 12.8 | 21,200 |
| Kelsey Field, Starr County | 8,307 | 9,500 | 1,067 | 6 | 1 | 16 | 1,067 | 67 | 3.5 | 4,200 |
| Kelsey Field, Starr County | 8,005 | 9,982 | 1,765 | 6 | 1 | 26 | 1,756 | 67 | 1.4 | 2,000 |
| Angel City Field, Goliad County | 8,457 | 10,500 | 1,465 | 6 | 1 | 14 | 1,465 | 104 | 4.0 | 4,700 |
| Sebastian Area, Cameron County | 9,731 | 11,180 | 1,349 | 8½ | 1 | 10 | 1,349 | 135 | 1.5 | 1,500 |
| TOTAL | | | 16,446 | | 15 | 235 | | | | $141,600 |

*Estimated from records on offset wells.

regions where conditions permit, and currently much air or gas drilling is being done in West Texas and New Mexico. Indications are that this newest adaptation of the rotary technique will spell the final word of doom for the cable-tool rig, that has held what place it has in the drilling picture mainly by virtue of its ability to drill with reasonable efficiency under the very conditions where the rotary, now fed with air instead of mud, is setting new records.

**Slim-hole drilling.** Several of the previously mentioned drilling developments have contributed to the recent successful trend toward small-diameter holes under conditions of depth and formation problems that previously required the heavy-duty approach of larger drilling equipment. Humble Oil & Refining Company reduced the cost of some 72 wells by 14 per cent in 1955 by trimming hole sizes. A portion of the savings, of course, came from a reduction in the diameter (and tonnage) of tubing and casing used, an advantage of increasing significance. The small-diameter, or "slim" hole is gaining in acceptance in all areas.

**Formation evaluation.** A rather large amount of research and development in the broad fields of formation evaluation and well completion has been carried out by many oil operators, suppliers, and service companies. At least a portion of the charges for this work should be allocated to drilling since it has accounted for large reductions in total well costs in many instances. Important examples of this research include perfection of the casing collar-radioactive log tie-in system of well-depth correlation; improved techniques and apparatus for formation logging, testing, and sampling; more efficient guns for casing perforation, some of which can be run through the well tubing, under pressure, if required, and newly found knowledge concerning the effect of well-fluid properties at the time of perforation on well productivity.

**Mechanical improvements.** Finally, in the field of mechanics, considerable equipment research and product development on the part of dozens of suppliers and operators has provided important improvements in the overall drilling machine, its accessories, its sources of power, and its means for power transmission. New and more efficient types of derricks, both fixed and portable, and improved rig-moving equipment have been made available from the same supply sources. Significant advancements certainly have been achieved by the manufacturers of tubular goods. It is unfortunate from the standpoint of this report that there is no simple example to gage the increase in efficiency which these advancements have contributed.

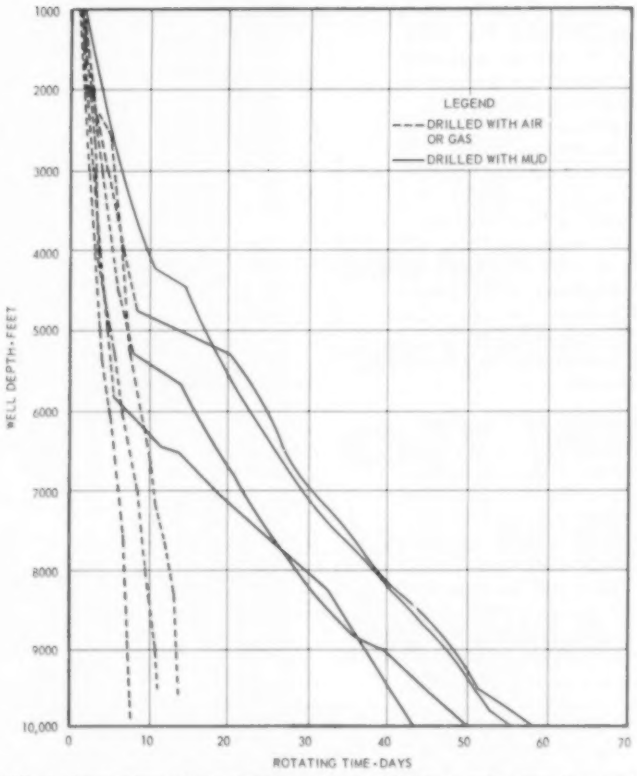



FIG. 2. **Comparison of air or gas and mud drilling** is made here in several Southwest Texas wells. All were drilled under otherwise comparable conditions.

## Effect of Drilling Research

An actual rough check on the relevancy of Humble cost data can be gained by comparing costs per foot for various depth wells (Fig. 3) with what are believed to be quite close estimates of U.S. average drilling costs for the year 1953 based on surveys conducted jointly by the American Petroleum Institute, Independent Petroleum Association of America, and Mid-Continent Oil and Gas Association. The cost data from the industry survey and the average Humble figures correlate quite closely with depth.

Accepting the Humble data as representative, then, Fig. 3 shows a comparison of the total cost by depths of 816 onshore wells drilled in 1950 with 857 wells drilled in 1955. In spite of the fact that a drilling-cost "index" based on such cost factors as labor, material, equipment, and services increased 25 per cent* during the five-year interval covered by the comparison, the data show only a slight increase in the cost for shallow wells and an actual reduction in the cost of wells deeper than about 12,000 ft! As a matter of added interest and to isolate the effect of inflation, the cost data for 1950 are also plotted in terms of 1955 dollars; and the overall improvement in drilling efficiency is shown in its true magnitude. On this basis of constant dollars, total well costs decreased from 10 per cent for 3000 ft wells to about 40 per cent for wells in the 15,000 ft depth range over the five-year interval.

**TABLE 2—Comparison of Gas vs Mud Drilling—Vinegarone Field, Southwest Texas. Comparable Hole Size and Drilling Equipment.**

| Total Days | Interval — Feet From | To | Footage Drilled | Hours Rotated | Ft. Drilled / Hr. Rotated | Footage Per Bit | No. of Bits Used |
|---|---|---|---|---|---|---|---|
| | | | WELL NO. 1 MUD OPERATIONS | | | | |
| 80 | 1500 | 9504 | 8004 | 1198.0 | 6.7 | 62 | 128 |
| | | | WELL NO. 2 GAS OPERATIONS | | | | |
| 22 | 1581 | 9500 | 7919 | 224.25 | 35.3 | 377 | 21 |
| | | | WELL NO. 3 GAS OPERATIONS | | | | |
| 13.7 | 1594 | 9950 | 8356 | 183.5 | 45.5 | 557 | 15 |

*The drilling index of reference is used by Humble Oil & Refining Company and is made up of 13 well-cost items, 60 per cent of which on a value basis are composed of labor, wellhead equipment, and tubular goods. The cost of these three items, in particular, has advanced more rapidly than the items that make up the better-known Consumer and Wholesale Price Indexes, which explains why the Drilling Index has advanced 25 per cent during a period when a Consumers' Price Index has advanced only 11.3 per cent.

It seems obvious from consideration of the cost data presented that large-scale increases in drilling efficiency have occurred during the past five or so years. Furthermore, the substantial flattening of the cost-depth curves is vivid evidence that the industry is not only doing its overall drilling job more efficiently, but it is also capable, in spite of inflation, of drilling deep wells today that would have been economic failures only 5 or 10 years ago. Many influences have contributed to the greater efficiency and the larger capacity of the drilling rig; but the dominant one, it is believed, is the industry-wide research and development effort.

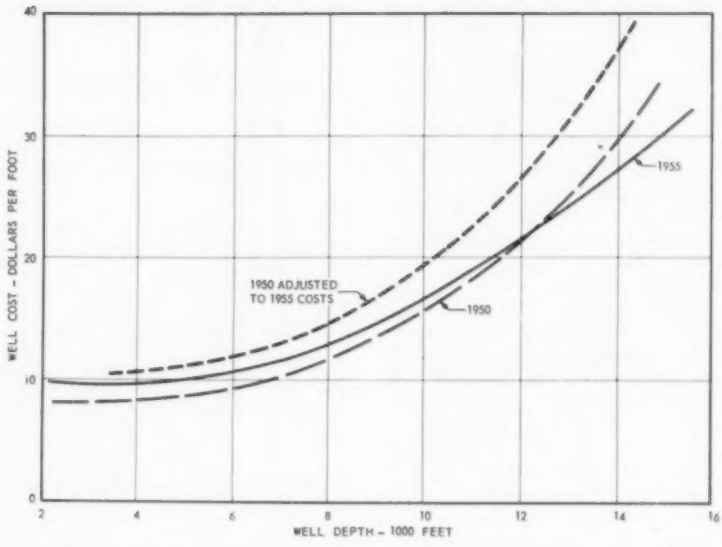



FIG. 3. **Well costs in 1950 and 1955,** as adjusted by Humble Oil & Refining Company. Data compiled from records of inland operations, mainly in western New Mexico, Texas and South Louisiana. Data for 1950 includes 816 wells, 1955 on 857 wells.

## Need for Additional Research

If gross business is the proper gage, then all indications are that petroleum-industry activity in the fields of drilling research and development should increase steadily. Austin Cadle, manager of economics department, Standard Oil Company of California, has estimated that by 1965 the domestic industry will need to be drilling 61,000 wells annually. However, if 1955's 56,000 wells against Cadle's estimated need for 45,000 wells that year is projected as a numerical difference, then we could expect nearer to 72,000 wells to be drilled in 1965. Taking this number as the most likely, a simple projection of 1955 costs and depths and other conditions would mean a total industry well cost in excess of $3¾ billion per year; and a proportionate increase in research expenditures would call for a composite annual budget of $13,000,000 (less offshore) in 1965. But these figures make no allowance for definite and long-established trends toward a large proportion of very high-cost deep wells (deeper than 10,000 ft) and toward greater and greater average well depths, not to mention offshore trends.

For the matter of average well depth, a continuation of past trends is certainly to be expected and the average well of 1965 is likely to be 4550 ft deep. This factor alone would tend to increase costs by about 20 per cent. And considering the effect of proportionately more deep wells, C. E. Reistle, Jr., AIME president, estimates that by 1965 the number of wells deeper than 10,000 ft will nearly double to more than 4000 per year. His information indicates further that the number of wells deeper than 16,000 ft will increase sevenfold in 10 years to an estimated 332 in 1965. With only these two factors in mind, increased average depth and a larger proportion of deep wells, it is reasonable to conclude that the cost of 72,000 wells in 1965 would approach $5 billion. Should this prove to be the case, we would be looking to the need for a research and development expenditure for drilling of at least $16,000,000 annually, not including additional large expenditures that will probably be in order for specialized offshore equipment development projects.

New research needs are many. Some of the many and significant technical problems that deserve attention and should lend justification if not an actual incentive for greater effort are listed.

The low oil production of the average United States well (12½ bbl per day in 1955) means that the average well utilizes but a fraction of the fluid-flow capacity of its tubing and casing. As a matter of fact, the casing is not used for producing purposes at all in most wells completed today. Tremendous savings in drilling and well-material costs for many wells can be effected through the development of "slim slim-hole" drilling and producing techniques utilizing smaller rigs to set 4 or 4½-in. surface pipe with a 1½ or 2-in. oil string, and perhaps no tubing at all as we know it today.

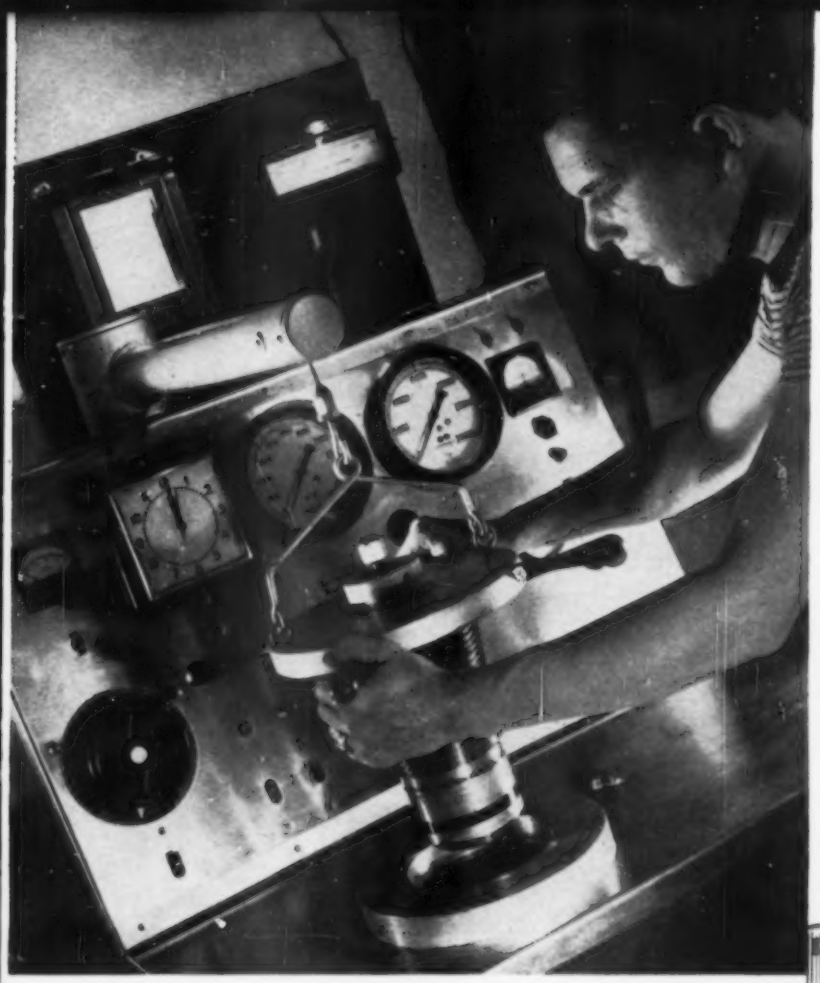
The value of extended bit life increases exponentially with depth. For this reason, if for no other, mechanical research and development on drilling tools of all types is yet a rich field of investigation. Several companies are experimenting with down-the-hole driving mechanisms, and outstanding results have been claimed in some instances although much additional work will be required to perfect these new drills. Out of this work it is hoped will come solutions to the problems of hole deviation that have plagued drillers since the inception of rotary and cable-tool drilling as well.

Use of air or gas as the circulating medium produces such phenomenal rotary drilling results that additional development work to extend this method to as many areas as possible is obviously desirable. In particular, solution of the water-shutoff problem would greatly broaden the application of air and gas drilling and deserves much immediate attention.

In the equipment fields there are many areas of needed improvement such as the continual demand for higher-strength drill pipe, casing, tubing, and wellhead apparatus as the development of drilling techniques permits greater and greater well depths. A critical equipment deficiency of long standing is the unsatisfactory life of the fluid-end components for high-pressure slush pumps. The frequent failure or rapid wear of these critical items results in high rig-maintenance costs and is essentially the reason for large investments in standby equipment in many instances.

Finally, a great amount of research and development is obviously justified and, indeed, essential to permit the industry to develop offshore leases. Entirely new methods and apparatus for drilling deep wells from floating platforms and completing wells at the ocean floor will certainly be required if the full exploration possibilities of the Continental Shelf are to be realized.

★ ★ ★



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**New permanent completion method uses no oil string**

# Parallel Macaroni String Cuts Well Costs

On 19 wells from 2300 to 7500 ft deep, macaroni string parallel to tubing cemented in open hole cuts costs from 30 to 50 per cent of conventional completion

**H. U. Garrett,**
*President, Garrett Oil Tools, Inc.*
*Longview, Texas*
**and**
**Donald M. Taylor,**
*Gulf Coast Editor*

A macaroni string run parallel to the tubing and cemented in the open hole has replaced the function of the production casing in 19 wells completed in recent months. A modification of the permanent type well completion method, this new idea was developed and field tested by Garrett Oil Tools, Inc., Longview, Texas, as a solution to the critical casing situation and spiraling well costs. On these 19 wells completed to date in East and West Texas with total depths ranging from 2300 to 7500 ft, costs ran 30 to 50 per cent less than conventional completions to comparable depths in the same areas.

Functionally, the technique is almost identical to a permanent completion except that the external macaroni string is substituted for the casing-tubing annulus. This small parallel tube provides communication between the lower part of the tubing and the surface so that direct or reverse circulation can be established when the well is to be killed, stimulated, or worked over.

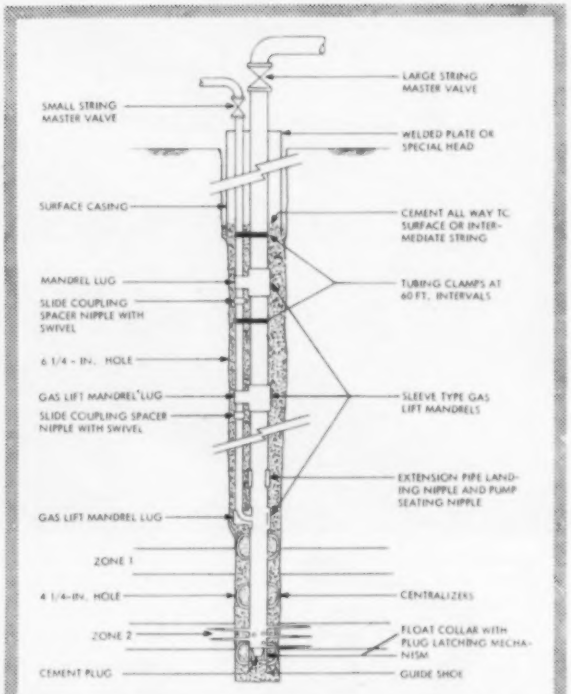
Completed in this manner, wells can be gas lifted — or with the addition of a pump seating nipple, they can be rod pumped. Moreover, they can be squeezed, fractured, acidized and repaired mechanically; and in most instances, the completion interval can be changed by the simple expedient of setting a wire-line bridge plug and perforating.

In addition, wells can be dually completed, with one formation producing through the macaroni string and the other through the tubing. Adding a second macaroni string makes triple completions possible.

It should be noted that on the 19 wells completed to date, little change has been made in the technique from first to last. No real "bugs" developed although the wells varied considerably in depth and were located in both East and West Texas. While the deepest well completed by the new method was only 7500 ft, several operators are planning deeper ones this year.

## The Savings

**Aside from the reduction in workover costs during the life of the well, the new method of permanent completion effects a sizeable savings in the original completion. These savings come through elimination of the production casing (only the tubing and macaroni string extend below the surface pipe), through exploiting the advantages of slim-hole drilling and through completing the wells with wire-line service trucks.**


LARGE STRING MASTER VALVE
SMALL STRING MASTER VALVE
WELDED PLATE OR SPECIAL HEAD
SURFACE CASING
CEMENT ALL WAY TO SURFACE OR INTERMEDIATE STRING
MANDREL LUG
TUBING CLAMPS AT 60 FT. INTERVALS
SLIDE COUPLING SPACER NIPPLE WITH SWIVEL
6 1/4 - IN. HOLE
GAS LIFT MANDREL LUG
SLEEVE TYPE GAS LIFT MANDRELS
SLIDE COUPLING SPACER NIPPLE WITH SWIVEL
EXTENSION PIPE LANDING NIPPLE AND PUMP SEATING NIPPLE
GAS LIFT MANDREL LUG
ZONE 1
4 1/4-IN. HOLE
CENTRALIZERS
ZONE 2
FLOAT COLLAR WITH PLUG LATCHING MECHANISM
CEMENT PLUG
GUIDE SHOE

**Tubing and macaroni string cemented in open hole.** The macaroni string permits the well to be killed, worked over and stimulated. Note that the strings are interconnected at several points. This permits gas lift and direct or reverse circulation.

**Once the cement plug reaches bottom, the drilling rig is moved off. Too, there is a reduction in the cost of wellhead equipment.**

Extent of these savings is pointed up in the cost analysis of a 2450-ft well completed by this method recently near Waskom, Texas. Included in the total are the costs to acidize, fracture, and to place the well on artificial lift. Note that the well's share of gas compressor for gas lift is included along with all wellhead and surface equipment except the gathering lines and tank battery.

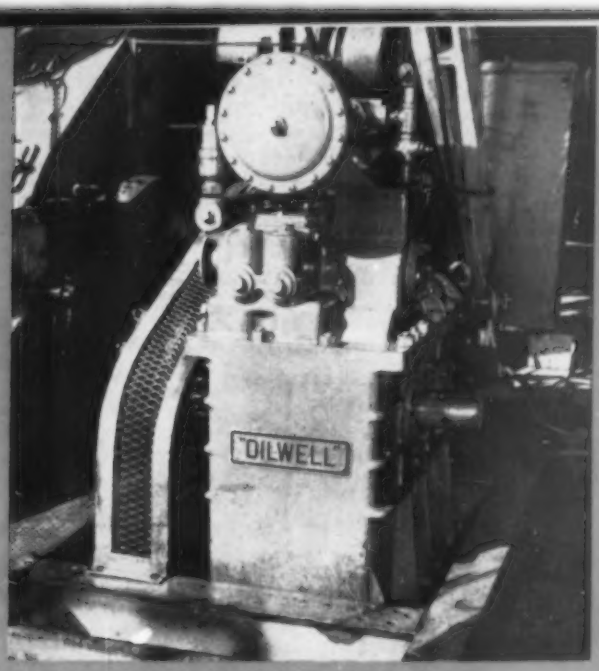
**Well Cost Analysis**

| | | |
|---|---|---|
| 1. | Staking location and digging pits | $ 160.00 |
| 2. | Drilling, using very light unit, contracted to drill 2450 ft | 3,250.00 |
| 3. | 100 ft of 7-in. surface pipe @ $1.95 per ft | 195.00 |
| 4. | Cement for surface and long string, 350 sacks @ $1.40 per sack | 490.00 |

*You can...*

- **drill straighter holes**
- **reduce risk of twist-offs**
- **get more footage per bit**
- **improve time-on-bottom ratio**

*with...*

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# "OILWELL" Automatic Drilling Controls

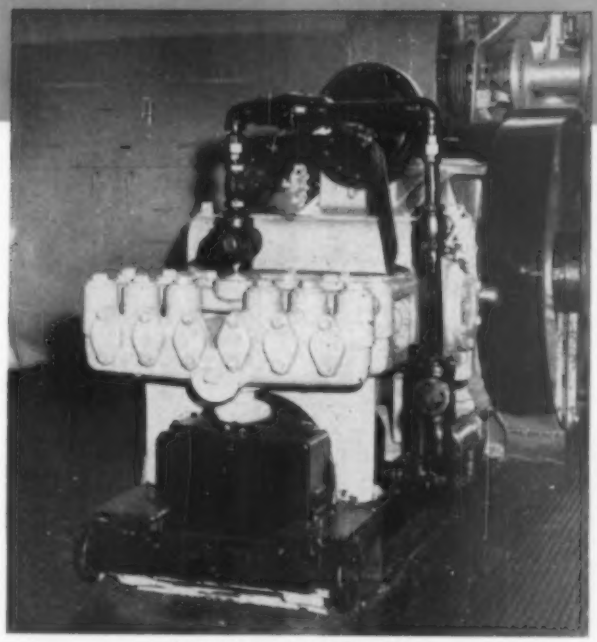
***"Oilwell" pioneered the first successful drilling control back in 1934. Now, hundreds of satisfied users have benefited by this experience and know that it pays to buy the best!***

FIELD REPORTS from one drilling company after another form the basis for this headline statement. And it's all because of the extreme accuracy with which these units enable drillers to maintain the most effective weight on the drilling bit at all times, regardless of formation changes.

In manual feed-off practices, with the driller riding the brake lever, it is normal to overload the bit temporarily, then allow it to drill off. But with an "Oilwell" Drilling Control, the feed-off rate of wire line from the draw works drum is controlled by mechanical means and operates automatically. Selection of high or low speed ratio is provided for light or heavy drill-string loads so that bit-weight control can be effectively utilized from the beginning to the end of drilling operations.

With the addition of this control equipment, drillers are able to avoid the normal abuses to both drill string and bit. In fact, users have estimated that these units pay for themselves in every well where quick-changing strata with slanting formations hold the ever-present danger of crooked holes and twist-offs. They're also particularly effective during reaming down operations, diamond coring and milling.

*Why not adapt your draw works for drilling-control operation? See your "Oilwell" Representative for details.*



NO. 15 FOR DEEP DRILLING

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TRADE MARK

UNITED STATES STEEL

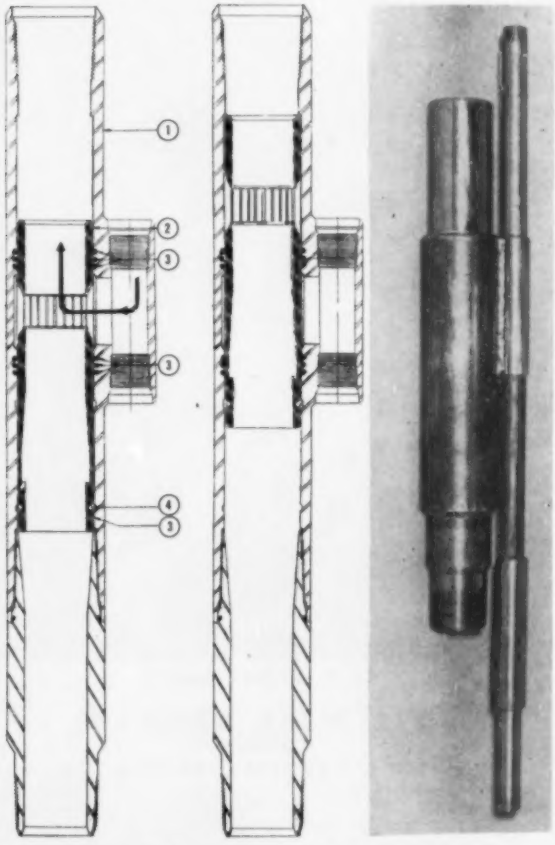
| | | |
|---|---|---|
| 5. | Cement truck | 205.00 |
| 6. | Electric log | 370.00 |
| 7. | 2445 ft of 2-in. tubing @ $ .75 per ft (new) | 1,834.00 |
| 8. | 2435 ft of ¾-in. pipe @ $ .40 per ft (new) | 978.00 |
| 9. | 3 sleeve type mandrels | 434.00 |
| 10. | Free piston, lubricator, and controller | 835.00 |
| 11. | Neutron log | 194.00 |
| 12. | Perforating 80 shots | 780.00 |
| 13. | Acid — 1000 gal | 700.00 |
| 14. | Frac mix with 30,000 lb sand | 1,565.00 |
| 15. | Wire-line truck | 60.00 |
| 16. | Well's share of compressor cost to place on gas lift including injection lines and suction lines | 2,500.00 |
| | | $14,550.00 |

A standard completion in this same area utilizing a means of artificial lift other than gas lift would cost about $21,000. Thus, the saving is 30.8 per cent. Such sizeable savings can, in many instances, determine whether or not a well should be completed or abandoned.

From the above analysis it is readily apparent that the deeper the hole, the greater the savings in drilling and completing the well. This proved true on a 7500 ft well where 2⅞-in. OD tubing was used as the oil string and 1-in. tubing for the macaroni string.

## How Wells Are Completed—Step by Step

**Sizing the hole.** In most instances a 6¼-in. hole is ample. It will clear the sleeve type mandrel fitting for all combinations of tubing and macaroni strings up to 2⅞-in. tubing and 1¼-in. macaroni.




**Sleeve type mandrels** that can be selectively opened to provide communication between the two strings. No. 1 — mandrel cage; No. 2 — sliding sleeve; No. 3 — "O" rings; No. 4 — snap-ring. When sleeve is up, the "O" rings will seal against a 5000 psi pressure differential between the two strings.

However, it should be pointed out that it is not always practical to drill the smallest hole possible. Even though the sleeve type mandrel for 2⅜-in. tubing used with ¾-in. macaroni has an outside diameter of only 4 21/32 in. and can easily run inside a 5-in. hole, other factors should be considered insofar as hole size is concerned. For instance, use of the smallest bit in slim-hole drilling is not always the most economical program. Shorter life of small roller bits may mean additional round trips, etc.

Yet, it is often feasible to drastically reduce the hole size once the top of the uppermost production formation has been reached. Hole below this point only needs to be large enough to accommodate the 2-in. tubing, and any hole diameter above 4-in. is ample.

**Selecting the rig.** A relatively light drilling rig will suffice. No long strings of heavy casing are to be handled and drill pipe for slim-hole drilling usually ranges from 2⅞-in. to 3½-in. OD. Although the drilling time may be slightly longer than for a large rig, the overall drilling cost may be reduced as much as 50 per cent. The rig day rate is also reduced considerably. However, this is a negligible factor since the drilling rig can be moved off as soon as the cement plug reaches the bottom of the tubing. **All perforating, acidizing, washing, and fracturing is done by wire-line trucks.**

**Sizing surface intermediate casing.** The surface casing or intermediate strings (if any) need only be large enough to pass the largest bit to be used. Since 6⅛-in. and 6¼-in. bits are most popular in slim-hole work, 7-in., 20-lb casing allows ample clearance for the bits. If an intermediate string is anticipated, the surface string must be large enough to run a 7-in. bit through it.

**Sizing tubing and macaroni strings.** Generally speaking, size of both strings varies with depth and possible workover problems to be encountered. The oil string is 2⅜-in. to 2⅞-in. tubing (and at greater depths possibly 3-in.). The macaroni string may be as small as ¾-in. in wells under 2000 ft; but as depths increase, its size should be increased to obtain greater mechanical strength and, more important still, to minimize pressure drop in reverse circulating, gas lifting, etc.

At 7500 ft it is advisable to use 1¼-in. tubing. At greater depths, the size may be increased to 1½-in. or better.

In holes below 10,000 ft, both strings probably will be telescoped, with an oil string made up of 3-in. at the top and reducing to 2⅞-in. and 2⅜-in. down the hole. The macaroni string could telescope from 2⅜-in. to 1¼-in. in the same well. The mechanical and hydraulic advantages of such a practice are obvious.

**Running the pipe.** Here is a step by step procedure that will serve as a guide in running the two strings of pipe in the hole:

1. On the bottom of the oil string, run a bull plug with a 1-in. hole directly in bottom and five ¼-in. holes. This rounded bull plug then serves as a guide shoe.

2. Run a pin collar a short distance above the guide shoe (bull plug) to serve as a stop for the cement plug. If desired, a reduced size float shoe with ball and seat may be used. It may also have a special latching mechanism so that when the cement plug is pumped to bottom it will stay latched preventing the plug or cement from backing up.

3. Run enough oil string to reach from the bottom of the well to approximately 30 ft above the uppermost zone to be tested. Be sure to run sufficient pipe to clear any shoulder if the hole changes sizes. Place centralizers on proper spacing. **One of the advantages of this method of completion is that from the top producing formations on down, centralizers are highly effective because of the limberness of the 2-in. pipe. This makes for a better cement job, and will probably eliminate many squeeze jobs.** Scratcher can also be used if desired.

4. Place the first sleeve type gas-lift mandrel at this point and prepare to run the sleeves closed and grease packed on the inside. Although it may not be necessary, sleeves run with 100

per cent success have been grease packed to prevent cement from adhering to the sliding surfaces. This is an inexpensive measure of insurance.

5. Start the macaroni string in the hole at the position of the first sleeve, running it parallel to the oil string. The macaroni is screwed directly into the sleeve mandrel plug.

6. If rod pumping is anticipated, a pump seating nipple should be run above the sleeve using a 4-ft minimum length tubing sub between the sleeve and nipple. In the absence of a seating nipple, however, a pump can be set later on a tubing packer.

7. To anticipate full permanent type completion work, a suitable landing nipple for hanging an extension pipe should be placed on the joint above the bottom sleeve. It can also serve as a seating nipple for a pump.

8. Run the two strings parallel to each other using suitable tubing clamps to strap the tubing together at approximately 60-ft intervals. Since the pipe is to be cemented in place, a strong adhesive nylon tape can be used to wrap the two joints together at 30-ft intervals, thereby eliminating the cost of tubing clamps.

9. If the well is to be gas lifted, spacing of the mandrels should follow standard gas-lift spacing practice appropriate to the producing conditions anticipated.

10. Connect the macaroni string to all gas-lift mandrels consecutively using a special slide coupling to join up between sleeves and to allow rotation for make-up.

11. Place centralizers where deemed advisable so the tubing will be centered in the hole, and cement evenly distributed.

12. If the capacity of the surface string is to be used as a surge chamber in a closed rotative gas-lift system employing compressors, an additional sleeve mandrel, **not** connected with the macaroni, should be placed one or two joints up inside the surface casing to provide for washing out the annulus.

13. Complete both tubing strings to the surface, carrying the weight on the oil string. Keep it on elevators in order to move it while cementing.

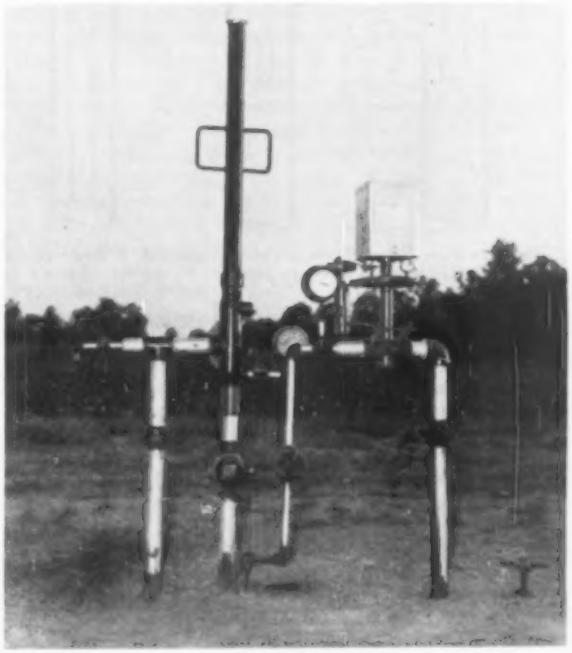
14. Before starting cement, the macaroni should be filled with oil, pressured up to say 2000 psi and shut in. This is a safeguard against the possibility of a sleeve being accidentally opened and will insure that no cement will get out of the oil string.

**Cement procedure.** (1) Precede the cement with 4 or 5 bbl of water. (2) Start the cement down the oil string. (3) Use a cementing plug to follow the cement down the pipe. Plugs are available for the various tubing sizes. (4) Pick up the pipe about 6-in. per 1000 ft of depth to allow for thermal expansion due to the heating effect of the cement. (5) Follow the plug with oil or water (preferably oil). If very high bottom-hole pressure is expected immediately after gun perforation and a tubing head pressure over 4000 psig is visualized, the cement plug should be followed by appropriately heavy mud. (6) For shallow wells, cement can be brought all the way back up to the bottom of the surface pipe. This provides rigidity for the two pipe strings, an insurance against leaks, and a protection against external corrosion. (7) Allow appropriate cement setting time, holding surface tubing pressure to prevent the plug and cement from backing up in the absence of a plug holder.

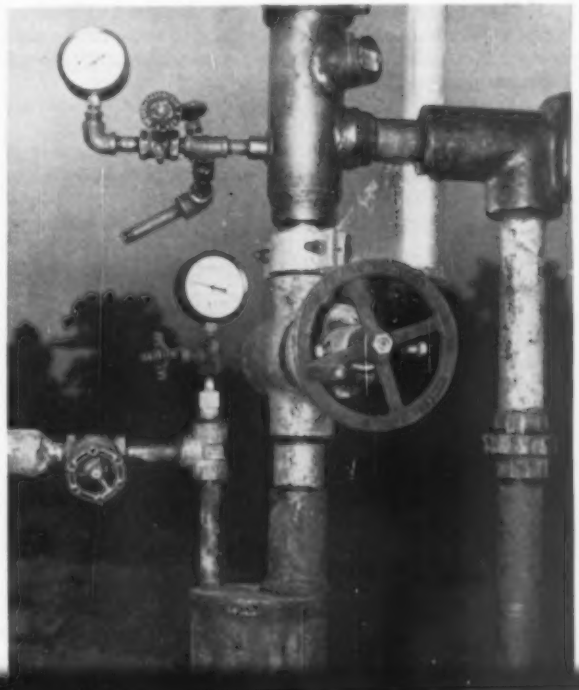
**Installing trees.** One of the major savings realized in this method of completion is the wellhead hook-up. For shallow and low pressure production, one master valve for the oil string and one master valve for the macaroni are all that are needed. These should be full bore valves. The two strings can be terminated by bringing them through a plate which is welded to the top of the surface casing and to the two strings of tubing. If welding is undesirable, a special head is available for packing off the two strings. If the surface casing is to be used as a volume chamber, this head must be rendered adequate for the pressures anticipated. Since it comprises only two master valves (generally screwed type), the tree cost is very appreciably reduced. Tubing subs can be used near the surface so that no cutting of the oil string is necessary.

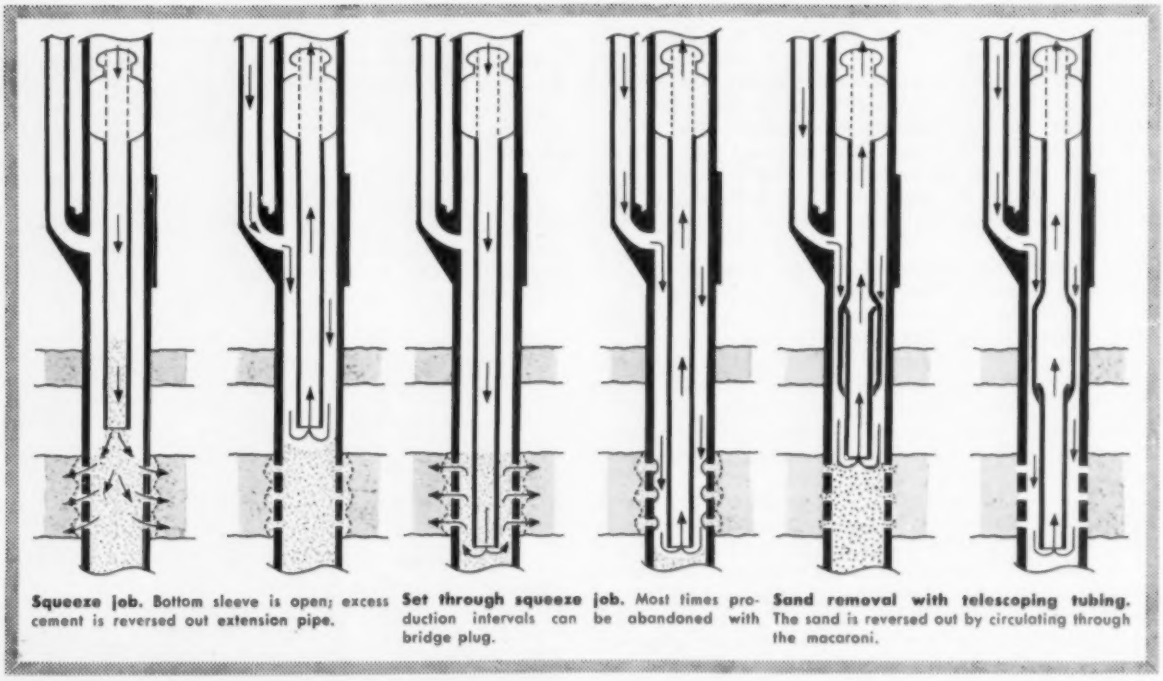
**Perforating.** Since the cement has been displaced with oil, the well is ready to perforate once the cement is set. A regular tubing perforating gun can be used. Tubing guns offer very good penetration as proved in numerous permanent type completions.

The hydrostatic head of the oil column in the pipe will usually be sufficient to hold the formation pressure after shooting. However, if higher pressures are encountered, the lubricator stuffing box allows a 3/16-in. line to be retrieved against 3500 psig or a 5/16-in. line against 1500 psig tubing pressure. These values have high safety factors, but for very



**Christmas trees** of two of the wells completed by this method. One of the advantages of the macaroni string is that it can be used to take accurate bottom-hole pressures during fracturing without making allowances for friction losses.





**Squeeze job.** Bottom sleeve is open; excess cement is reversed out extension pipe.

**Set through squeeze job.** Most times production intervals can be abandoned with bridge plug.

**Sand removal with telescoping tubing.** The sand is reversed out by circulating through the macaroni.

high pressure, the 3/16-in. line only should be used.

With all the sleeves in the closed position, the well can be placed on production through the oil string (tubing) immediately after perforating.

### Acidizing Procedure

The well can be acidized as easily as with any other completion equipment. The following stepwise procedures are followed in acidizing:

1. With wire line tools, open the lowermost sleeve which gives communication with the macaroni string.
2. Close the master valve on the macaroni.
3. Pump the acid into the oil string.
4. If it is desirable not to pump too much fluid back into the formation, fluid in the oil string, displaced by the acid, can be produced through the macaroni.
5. Proceed to pump the acid out into the formation.
6. Spent acid is brought out by producing through the oil string, or if additional velocity is needed to bring out an acid and water mixture, the production also can be routed through the macaroni.

### Sand-Fracturing

Sand-fracturing a well can be as easily carried out as with any other well completion. The procedure is essentially the same as for acidizing:

1. If the bottom sleeve is not open, it should be opened by a wire line tool.
2. Inject into the oil string whatever fluid is desirable to break down formation.
3. If it is not desirable to displace all of the fluid in the oil string out into the formation ahead of the frac-mix, it can be produced through the macaroni string. If this is done, the master valve on the macaroni should be closed in good time to prevent the mixture from flowing into it.
4. On closing the macaroni master valve, the frac-mix is then pumped out into the formation.
5. A pressure gage should be placed on the macaroni string. This pressure reading plus the hydrostatic head pressure is the actual pressure at the sand face. It is to be expected that the macaroni gage pressure will differ from the pump gage pressure. The difference is due to friction loss down the oil string.
6. With the bottom sleeve open, the frac-mix can be reversed out at anytime, if necessary, by pumping oil down the macaroni and flowing up through the oil string.

### Artificial Lift

With this method of completion the well can be placed on any type of artificial lift available today.

**Gas-lift.** With gas-lift sleeve type mandrels already in the oil string, the running of retrievable gas-lift valves with wire line tools is all that is necessary to place the well on gas lift. Upon landing the valve in the sleeve, communication is automatically established with the macaroni.The injection gas flows from the macaroni through the sleeve, through the gas-lift valve, and on into the oil string.

The surface pipe annular space may be used for a volume surge chamber if the well is placed on intermittent flow. If continuous flow and one-point gas injection is desired, the operating sleeve simply can be left open without any gas-lift valve and the gas injected down the macaroni at a controlled rate from the surface. The injection pressure and flow rate can then be lowered to reach the point of most efficient lift. If intermittent gas lift is anticipated in deep wells, the macaroni string sizes should be selected large enough to avoid excessive frictional pressure drop. A string of 1½-in. tubing can be used for the macaroni in deep wells.

**Free piston.** The free piston incorporates a pack-off sealing element against the walls of the pipe with which 70 to 90 per cent volumetric efficiency is obtainable in bringing a slug of fluid to the surface. The piston travels the entire length of the tubing string. One type comprises an inner valve that opens when it reaches the surface and closes upon contact with a tubing stop at bottom.

**Beam pumping.** No difficulties should be encountered in running a string of rods and placing the well on "pump." If a seating nipple has not been run, the pump can be set on a pump anchor or in the permanent completion landing nipple. Again the bottom sleeve should be opened and the pump placed above the sleeve. By opening the master valve on the macaroni, the same results as opening the casing wing on a

standard completion can be obtained. Also, a considerable degree of control of back pressure on the formation can be obtained by placing a back-pressure regulator on the macaroni.

Under gassy conditions, a 1-in. or ¾-in. dip tube can be extended from the pump down the oil string to serve as a gas anchor. The annulus between the dip tube and oil string then acts as a gas separator, the gas going up the macaroni string.

**Hydraulic pumping.** If the well is to be put on hydraulic pump, the power oil is pumped down the tubing, and the macaroni string strapped to it can serve as the production string.

The pump receiver assembly should be run initially on the tubing and properly connected to the macaroni string. This assembly is cemented in place. A special sleeve is used temporarily to keep the macaroni closed while cementing the two strings in place. The pump and standing valve can be "flowed" out by reverse pumping down the macaroni. Permanent type completion work can be successfully carried on through the pump receiver assembly.

## Testing Different Zones

If various zones are to be tested, the bottom zone should be perforated first. After a satisfactory test has been completed, this zone can be shut off by setting a wire line plug. It should not be necessary to squeeze, unless channeling along the pipe is evident. If a cement squeeze is desired, it can be conducted by standard permanent type completion procedures.

If a plug has been set, or if the lowermost zone has been squeezed, the next zone up the hole is then ready to be perforated and tested. Successive zones up the hole can then be treated in the same manner.

Each individual zone, if it is necessary, can be placed on any of the previously mentioned methods of artificial lift for testing.

## Special Applications

**Chemical injection.** Chemical can be injected directly down the macaroni for any corrosive conditions. This would hold true for straight flow, gas lifting, use of the free piston, and for beam-type pumping. For hydraulic pumping, the chemical can be co-mingled with the power oil.

**Paraffin conditions.** By using the free piston, paraffin is automatically removed each time the piston makes a trip. For beam pumping, a paraffin solvent can be injected down the macaroni. For hydraulic pumping, the paraffin solvent can be co-mingled with the power oil.

**Bad sand conditions.** If the bottom of the oil string sands up, the lowermost sleeve is opened and regular telescoping pipe is landed in the receiver nipple above the sleeve. Wash fluid is then pumped down the macaroni through the sleeve port and down the annulus between telescoping tube and oil string. Sand can be washed out up the oil string. Sand, of course, can also be bailed with a tubing bailer. The additional sleeves up the tubing also allow any possible bridges up the hole to be washed out in the same manner. The telescoping pipe with a special landing tool can be landed anywhere in the oil string, thereby eliminating the need for landing nipples at various points in the tubing. This particular landing tool can also be used at bottom if desired, but if sand-frac, cement squeeze, or other high pressure operation is anticipated, the permanent landing nipple is preferable.

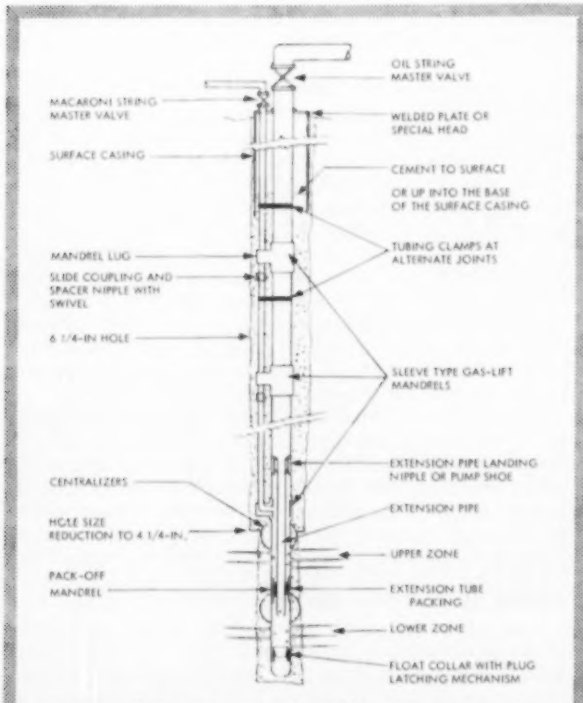
## Dual Completions

Where the two zones are to be individually tested, the lowermost is perforated first then treated if necessary, and tested.

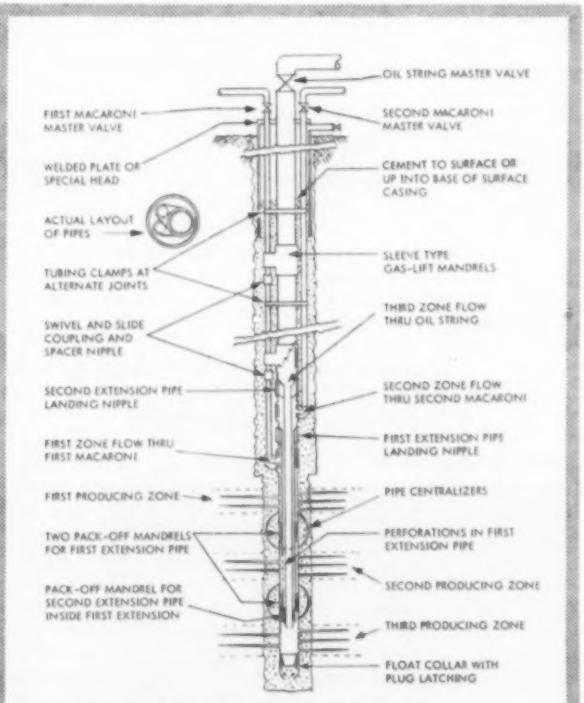
A wire line plug is then run and set just above the first perforations.

The upper zone is then perforated, treated and tested, and the process repeated as often as there are separate producing formations.

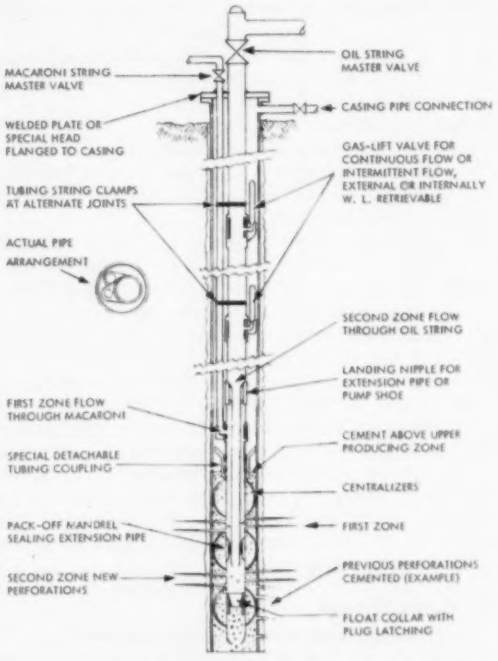
Where two producing zones are to be separately produced


OIL STRING MASTER VALVE
MACARONI STRING MASTER VALVE
WELDED PLATE OR SPECIAL HEAD
SURFACE CASING
CEMENT TO SURFACE
OR UP INTO THE BASE OF THE SURFACE CASING
TUBING CLAMPS AT ALTERNATE JOINTS
MANDREL LUG
SLIDE COUPLING AND SPACER NIPPLE WITH SWIVEL
6 1/4-IN HOLE
SLEEVE TYPE GAS-LIFT MANDRELS
EXTENSION PIPE LANDING NIPPLE OR PUMP SHOE
CENTRALIZERS
EXTENSION PIPE
HOLE SIZE REDUCTION TO 4 1/4-IN.
UPPER ZONE
PACK-OFF MANDREL
EXTENSION TUBE PACKING
LOWER ZONE
FLOAT COLLAR WITH PLUG LATCHING MECHANISM

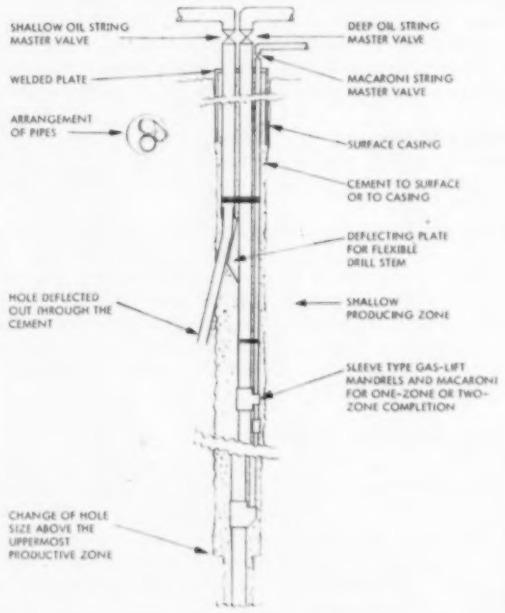
**Dual completion** using extension tubing. Both zones can be pumped.


OIL STRING MASTER VALVE
FIRST MACARONI MASTER VALVE
SECOND MACARONI MASTER VALVE
WELDED PLATE OR SPECIAL HEAD
CEMENT TO SURFACE OR UP INTO BASE OF SURFACE CASING
ACTUAL LAYOUT OF PIPES
SLEEVE TYPE GAS-LIFT MANDRELS
TUBING CLAMPS AT ALTERNATE JOINTS
THIRD ZONE FLOW THRU OIL STRING
SWIVEL AND SLIDE COUPLING AND SPACER NIPPLE
SECOND EXTENSION PIPE LANDING NIPPLE
SECOND ZONE FLOW THRU SECOND MACARONI
FIRST ZONE FLOW THRU FIRST MACARONI
FIRST EXTENSION PIPE LANDING NIPPLE
FIRST PRODUCING ZONE
PIPE CENTRALIZERS
TWO PACK-OFF MANDRELS FOR FIRST EXTENSION PIPE
PERFORATIONS IN FIRST EXTENSION PIPE
SECOND PRODUCING ZONE
PACK-OFF MANDREL FOR SECOND EXTENSION PIPE INSIDE FIRST EXTENSION
THIRD PRODUCING ZONE
FLOAT COLLAR WITH PLUG LATCHING

**Triple completion** using added string of macaroni.


OIL STRING MASTER VALVE
MACARONI STRING MASTER VALVE
CASING PIPE CONNECTION
WELDED PLATE OR SPECIAL HEAD FLANGED TO CASING
GAS-LIFT VALVE FOR CONTINUOUS FLOW OR INTERMITTENT FLOW, EXTERNAL OR INTERNALLY W. L. RETRIEVABLE
TUBING STRING CLAMPS AT ALTERNATE JOINTS
ACTUAL PIPE ARRANGEMENT
SECOND ZONE FLOW THROUGH OIL STRING
LANDING NIPPLE FOR EXTENSION PIPE OR PUMP SHOE
FIRST ZONE FLOW THROUGH MACARONI
CEMENT ABOVE UPPER PRODUCING ZONE
SPECIAL DETACHABLE TUBING COUPLING
CENTRALIZERS
PACK-OFF MANDREL SEALING EXTENSION PIPE
FIRST ZONE
SECOND ZONE NEW PERFORATIONS
PREVIOUS PERFORATIONS CEMENTED (EXAMPLE)
FLOAT COLLAR WITH PLUG LATCHING

**Permanent completion inside existing casing.** A modification of this technique can be used in extreme high pressure completions. The macaroni string can be used as a kill line in case of trouble.


SHALLOW OIL STRING MASTER VALVE
DEEP OIL STRING MASTER VALVE
WELDED PLATE
MACARONI STRING MASTER VALVE
ARRANGEMENT OF PIPES
SURFACE CASING
CEMENT TO SURFACE OR TO CASING
DEFLECTING PLATE FOR FLEXIBLE DRILL STEM
HOLE DEFLECTED OUT THROUGH THE CEMENT
SHALLOW PRODUCING ZONE
SLEEVE TYPE GAS-LIFT MANDRELS AND MACARONI FOR ONE-ZONE OR TWO-ZONE COMPLETION
CHANGE OF HOLE SIZE ABOVE THE UPPERMOST PRODUCTIVE ZONE

**Shallow zone completion for marginal sand** can be made through an extra string of tubing mounted above a deflecting plate.

and a completion made in a well with an existing string of casing to the full depth, a pack-off mandrel is included in the tubing string between the two zones. An extension tube, fitted with a packing to seal off the pack-off mandrel, is run in, suspended and locked into the landing nipple above the lowermost connection with the macaroni. Production from the upper zone is then taken through the annulus around the extension tube and up through the macaroni. Production from the lower zone is taken straight up. A detachable tubing coupling is used in a well where the casing annulus is utilized for gas storage. Artificial lift of any kind can be applied to the oil string. It will be readily understood that a crossover can be used to put the higher pressure flow into the macaroni and the weaker into the oil string.

Since the tubing above the detachable coupling can be pulled, changes can be made freely and, for instance, both zones can be gas lifted.

If there is no casing annulus for gas flow and both zones have to be artificially lifted independently, two macaroni strings would be installed, one for gas injection.

### Triple Completions

Commencing with say a 2⅞-in. OD oil string to be cemented through three productive zones, there is a large variety of minor changes possible in arranging the equipment. As before, each zone, from the bottom upwards, is perforated, acidized, sand-fractured, tested and plugged off before going on to the next zone. The lower section of the tubing is provided with two pack-off mandrels whose ID is slightly less than that of the extension pipe landing nipples and of the mandrel sleeves. One is between the first and second zones, the other between the second and third zones. The first extension pipe is perforated between the two seals which engage in these two pack-off mandrels and it, in turn, is provided internally with a pack-off mandrel in which the second extension pipe seals. In this way the zones may have considerable pressure differences and may be isolated and produced independently. Again, the weakest zone can be switched into the oil string and artificially lifted.

### Additional Shallow Sand Production

In some wells, production from deep zones may require running one or more macaroni strings to depths well below a comparatively shallow pay zone. The oil string, in such cases, cannot be perforated for the shallow oil.

For such wells a second oil tubing string is used. At the appropriate point, the main tubing string is fitted with a deflecting plate and the lower end of the new pipe located just over it.

After cementing, a bit is run on small drill pipe with flexible connections, as used in side wall coring practice, and a hole is drilled out through the cement away from the main oil string. This second oil string may be equipped with pump seating nipple or another string of macaroni pipe depending on what type of artificial lift, if needed, is preferred.

A second way of producing shallow sands above the bottom of the macaroni string is possible where there is at least one sleeve mandrel above the sand. In this case, the interval can be perforated, and the damaged macaroni string can be plugged off below the mandrel but above the damage done by perforations. Of course, the feasibility of this practice will depend on the location of the sleeve mandrel interconnections.

### Future of the New Method

Just as the proof of the pudding is in the eating, the value of this new method to the oil industry can best be ascertained by field installations. Even now, several companies are planning to use the new method on a trial basis during the coming months. If they prove as successful as the 19 wells completed by the method to date, many new marginal reservoirs may be added to the nation's reserves. ★ ★ ★

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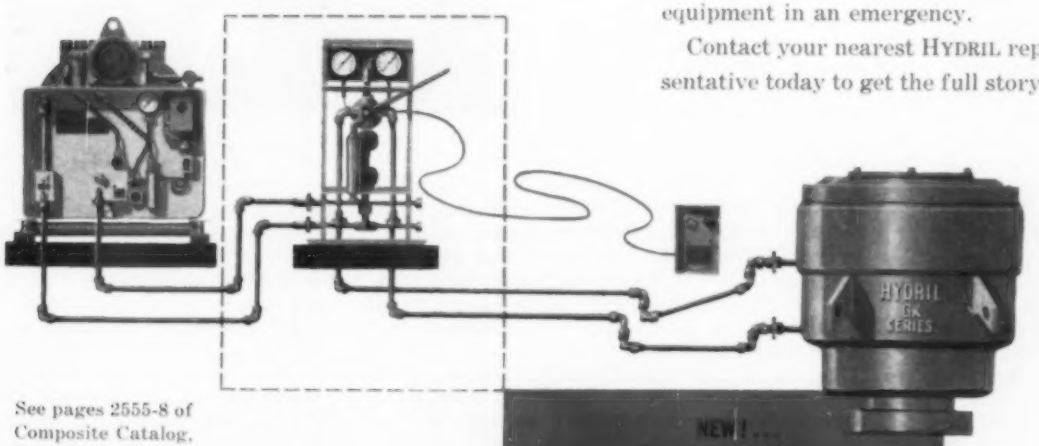


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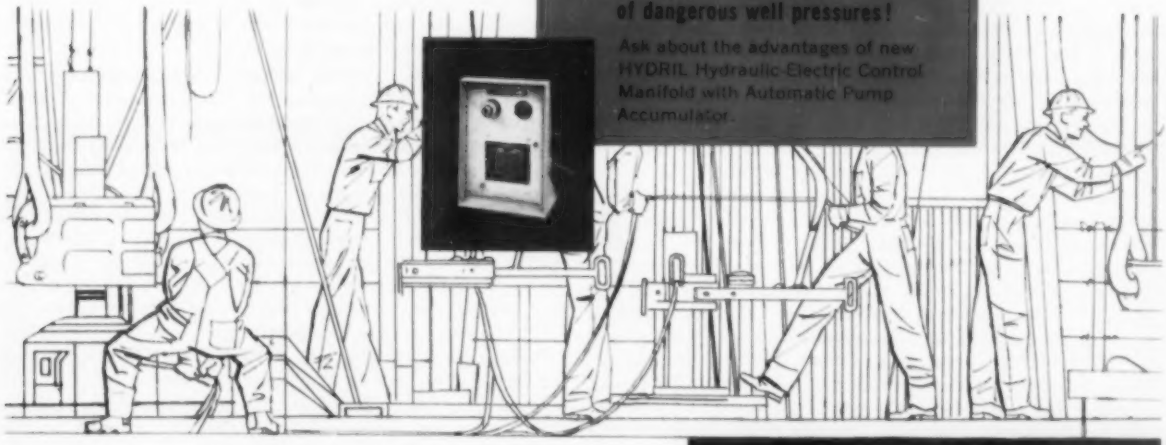

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**HYDRIL TAKES THE BLOW OUT OF BLOWOUTS**

**In Memoriam . . .**

# E. DeGolyer

*DeGolyer and MacNaughton, Dallas, Texas*

. . . man of many accomplishments

THE death on Friday, December 14, 1956, of Everett Lee DeGolyer, 70, in Dallas, Texas, was indeed a shock and a loss to this nation and the petroleum industry in particular. Oil historians will require several volumes to record his significant contributions that have directly and indirectly led to the prominent role now played by U. S. oil. He distinguished himself in his chosen field not only in this country, but abroad as well, to reach the highest pinnacle of his profession. The name DeGolyer is almost synonymous with modern petroleum geology, for he contributed heavily not only to the science of "earth study," but to its practical application in petroleum exploration. His continued efforts helped in no small measure to elevate the stature of his profession within industry to the position it now holds.

Germination of the idea behind the organization of the American Association of Petroleum Geologists came from a conversation he had in 1915 with Charles H. Taylor, then head of the department of geology, University of Oklahoma. In 1925, he was elected president of AAPG, and in 1945 was made an honorary member.

"De" as his close friends called him, was a born discoverer, and somewhat of an adventurer in many ways. Searching for oil fascinated him, and consumed the major portion of his productive life. Armed with a combination of practical and formal education on the subject, he contributed in large measure toward removing the element of "gamble" from petroleum exploration and putting it on a more scientific basis. The role he played in introducing geophysics to the industry is recorded in many places and will long be remembered.

He was instrumental in bringing in 1922 the torsion balance from Budapest to this country and putting it on a practical footing. Discovery of the Nash Dome in Fort Bend County, Texas, in 1926, marked the first oil field to be discovered by geophysical methods in the world. Through Geophysical Research Corporation which he founded in 1925, the refraction seismograph method was successfully applied to the search for oil production around salt domes. His keen interests in these structures led him to become a leading authority on salt domes. The reflection seismograph, condemned by many, posed a challenge. Under his direction, GRC physicists perfected this method as a geophysical tool in locating structures other than salt domes.

But, DeGolyer was always a geologist first, and was more interested in accomplishment than in "pride of authorship." He brought together a brilliant group of physicists, encouraged them, arranged appropriations, pooled his own keen knowledge of geology with their research.

Adventures in business, most of them allied with petroleum, were among the almost endless list of his activities. He would plunge headlong into a new venture that to many appeared a long shot. His boundless energy and enthusiasm pushed these undertakings from perilous beginnings to financial success. He had the uncanny ability to see possibilities of new situations or techniques, plus a geological and financial background almost unequalled in his field. He would start a company, work endlessly to make it succeed, then turn it over to others to operate. Of the companies he helped organize, the following stand out in the oil industry, several of which now operate as highly successful organizations: Amerada Corporation (forerunner of Amerada Petroleum Corporation and Amerada Refining Company) from which he resigned as chairman of the board in 1932; Geophysical Research Corporation, through which he pioneered the idea of a service company in the industry by taking geophysical contracts; Louisiana Land and Exploration Company; Atlatl Royalty Corporation, Felmont Corporation, Geophysical Services, Inc., and his own prominently-known, DeGolyer and MacNaughton, of which he was senior member until his death.

He contributed some of his best work in public service to this country. This phase of his "extra-curricular activity" started in 1918, again in the depression of 1933, and most significantly during the past World War II when he played a major role in the Petroleum Administration for War and later Petroleum Administration for Defense. In 1944 he was head of a Technical Oil Mission to the Middle East acting under the Department of Interior's Petroleum Reserve Corporation. Colleagues say he was particularly proud of the report he wrote, "Preliminary Report of the Technical Oil Mission to the Middle East." He also began his continued association with the Interstate Oil Compact Commission in 1938 and his notable reports to that body include "The Nation's Reserves of Natural Gas" which he prepared in 1945.

DeGolyer wrote hundreds of technical articles, starting in 1912, as well as several books. One of his active hobbies was that of collecting rare books, which he started during his first geological work in Mexico. In addition to the DeGolyer collection of the History of Science and Technology which he donated to Oklahoma University, his home library contains about 8000 volumes. For the past 15 years he was the guiding spirit behind the Saturday Review of Literature, which he aided financially in 1941.

These are but a few of his accomplishments, and perhaps he would treasure above all else the respect, friendship, and professional attitude afforded him by those with whom he worked. He will be badly missed by many, but his memory will serve as an inspiration to those who follow.

**Drawworks brake and drilling feed control combined in . . .**

# New Magnetic Particle Brake

Eddy-current type unit has constant braking torque independent of drum speed, is light weight and compact, and adaptable to well servicing and big rigs

**James A. LeVelle**
*Engineering Editor*

ADAPTATION of the magnetic particle principle to eddy-current electric drawworks brakes provides positive braking action, automatic feed-off control and a means of regulating rate of fall when lowering drill pipe. This new magnetic particle brake has the unique characteristic of constant braking torque from zero to maximum drawworks drum speed. These desirable features were made possible principally by the introduction of about 50 lb of iron powder in the air gap between the stationary magnetic field and rotor of an electro-magnetic brake. One of the new type brakes, designed and manufactured by The Baylor Company, Inc., of Houston, Texas, was installed on Sun Oil Company's Rig 15, now working in South Louisiana.

The outstanding feature of the new brake is that all these functions can be accomplished with one unit roughly half the size of dynamatic brakes. These functions are presently being accomplished through the use of an auxiliary brake and drill feed control units working in conjunction with the drawworks brake. Auxiliary braking is almost universally used at this time and a majority of the larger rigs are equipped with adequate drilling feed control systems.

Outstanding advantages of the new brake are savings in weight, floor space, and unit maintenance. There are indications that wear on rig brakes is further reduced and may permit some reduction in the size of brake drums. Also, simple controls show promise of being utilized to perform other safety and drawworks braking functions.

## Rig Brake Problems

The problem of dissipating the heat and energy generated when running casing and drill pipe has long been recognized. In a single trip to bottom with 10,000 ft of 4½-in. drill pipe, more than 1,000,000 Btu of heat and energy must be dissipated. Braking power required to stop pipe when near the bottom in many cases averages more than 1000 hp and with intermittent rates as high as 4000 hp.

The first step taken to increase brake life was the use of water cooled brake rims. Hydraulic and magnetic auxiliary braking systems were then developed to supply a large portion of the braking and reduce wear on the mechanical brakes. Two types of units most widely used are the hydrodynamic and the dynamatic or eddy-current units. Hydrodynamic brakes function similar to a centrifugal pump and dissipate energy through hydraulic friction. Control is provided by varying valve opening to increase or decrease the volume of water pumped. Dynamatic brakes are a form of magnetic brakes which absorb energy in the form of electrical energy or small eddy-currents. Control

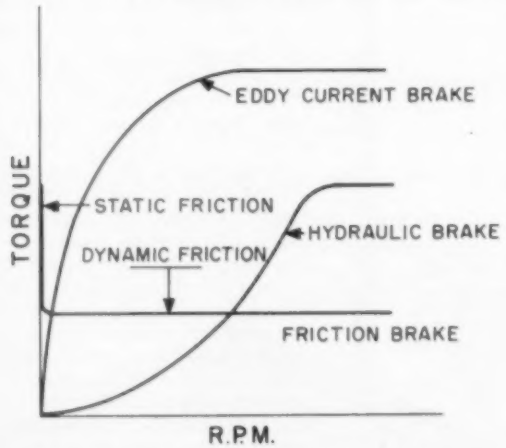


FIG. 1. **Torque characteristics** of typical brake systems used on drawworks today. Static torque of mechanical friction brake is roughly twice the dynamic friction.

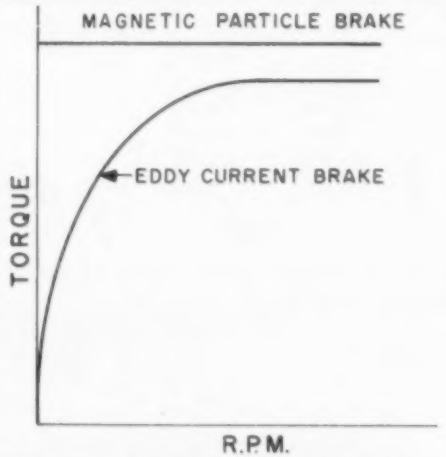


FIG. 2. **Comparison of magnetic particle brake** and eddy-current brake characteristics. Excitation power is reduced in the magnetic particle brake due to effect in reducing reluctance of the magnetic system.

is maintained by varying the magnetic field to increase or decrease braking action.

Characteristics of auxiliary brakes and also the friction brake on the drawworks are shown in Fig. 1. Static friction of the mechanical or friction brake is roughly twice the dynamic friction. The flat torque characteristic is desirable, and except for excessive wear encountered on the brake band and drum, would represent the optimum in braking control. The braking torque of both eddy-current and hydraulic units is dependent upon the rotational speed.

At any one setting, these units tend to govern the rate of descent of the pipe rather than provide a steady retarding torque. Due to its steeper curve and ability to absorb a large portion of the load at lower speeds, the eddy-current type brakes offers control over a wide speed range.

Drilling feed controls employed at this time are friction brake or clutch type units that are controlled by the dead line weight. Such a system regulates weight on the bit by adjusting friction on the brake or clutch face and thus suspending weight of drill stem less the weight on the bit. Units in use at this time are extremely accurate and are capable of holding the weight to within plus or minus 1000 lb. Most of these devices are equipped to provide both constant bit weight or constant penetration rates. Selection is made by switching the pilot mechanism from dead line weight to a time control system which feeds-off at the desired rate.

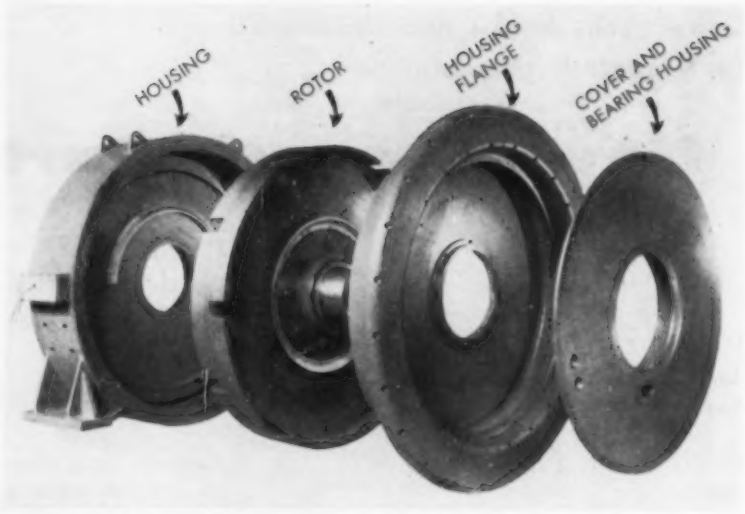


FIG. 4. **Principal parts** of magnetic particle brake. Coils to energize brake and cooling water courses for dissipating heat are contained in brake housing.

The magnetic particle brake is an eddy-current type brake design but has a constant torque characteristic and is independent of rotational speed as shown in Fig. 2. Energy is absorbed by both the eddy-current principle and friction between particles. Torque absorbed is proportional to density of the electro-magnetic field developed in the unit. Due to its high torque characteristic and control it can provide positive braking and controlled descent similar to a friction brake but without wear on the unit. By properly setting the torque, the unit maintains a fixed amount of pipe in suspension and thus will hold a constant weight on the bit as in current feed control systems.

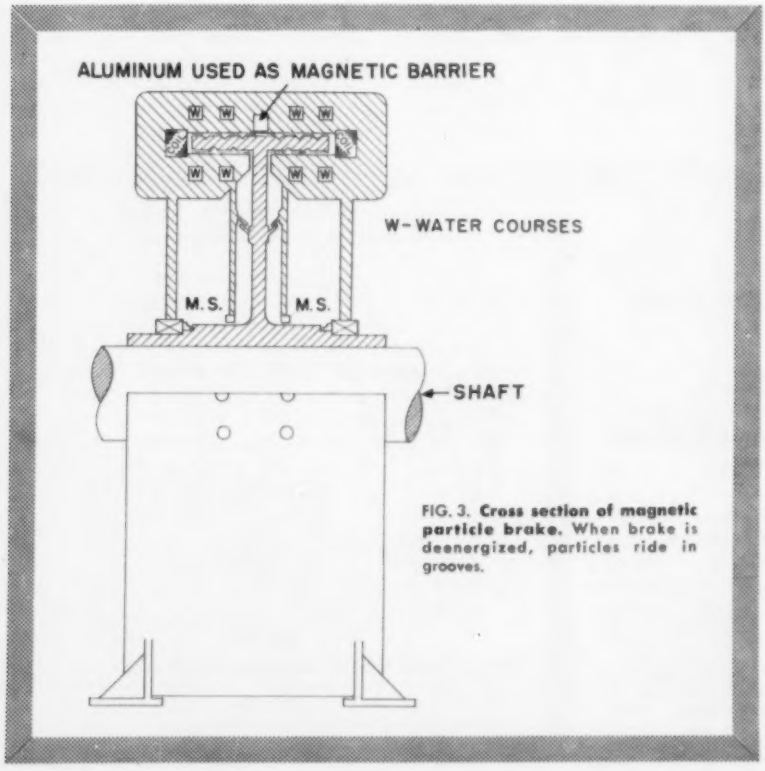


FIG. 3. **Cross section of magnetic particle brake.** When brake is deenergized, particles ride in grooves.

### The Magnetic Particle Brake

The magnetic particle brake developed out of research made on eddy-current brakes and clutches in an effort to reduce power requirements. Fundamentally, the power required to produce a given braking action is dependent upon the clearance between the fixed and rotating members. Expansion due to heat while operating limited the amount of reduction which could be made in the clearance between components. This gap between the magnetic field and rotor acted as a resistance and thus increased the field required for braking. Introduction of magnetic particles in this gap provided a path for the magnetic flux. Resistance was reduced and had the effect of greatly reducing the rotor clearance. Result was that power required to produce a given braking action was greatly reduced.

Through proper construction and selection of particle size and alloy, it was found that the brake or clutch operated at constant torque rather than being a function of speed as in the conventional eddy-current type unit. These principles have been incorporated in the magnetic particle brake. The brake

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also provides a torque that is proportional to the excitation current flowing through the electro-magnetic coils. Use of oscillating direct current has the unique feature of providing a constant retarding torque with both static and dynamic loads.

These new units consist of a magnetic particle brake, a skid mounted power rectifier and control unit, and driller's controls. The brake itself is simple, having only two mechanical parts; a rotor and a case or housing. Functional parts include two field coils, a drum type rotor, powder seals and the housing which is equipped with cooling water courses to carry off heat generated by the brake. Clearance area between the rotor and housing is partially filled with magnetic particles of an iron alloy. These particles are mechanically distributed in the unit by the rotation of the rotor and they operate in an electro-magnetic field of variable and controllable density. The rotor may be connected to the drawworks drum by either direct coupling or by chain drive and is normally mounted on the drawworks frame.

Rim of the rotor is both grooved and slotted to aid in distributing the iron powder and to reduce drag when the brake is not energized. The housing surrounds the "T" shaped cross section of the rotor and is provided with an electro-magnetic coil at each end of this section as shown in Fig. 3. Water courses are provided on both the outer flange and inner section of the brake housing. An aluminum ring, located in the center of the unit, serves as a magnetic barrier to prevent interference between the two magnetic coils. All major components are made of forged steel to insure optimum magnetic flux transmission qualities.

Labyrinth type seals are used on the flange of the rotor, and magnetic seals are installed at the hub of the rotor to prevent loss of powder. This latter seal consists of a ring of small magnets which collect any powder that passes the rotor seal. Particles collected on these magnets tend to form a solid barrier between the case and bearing sections. Conventional bearing seals are used to seal out moisture which would tend to ball up the powder in the system.

Magnetic particles are of a special non-oxidizing magnetic iron alloy which will pass through a 350 mesh screen. Anti-sintering materials are added to prevent sintering at temperatures up to1500F. During operation, high temperatures are periodically encountered with the result that there is some oxidation. However, this occurs at a slow rate and it is anticipated that sufficient indications will be received

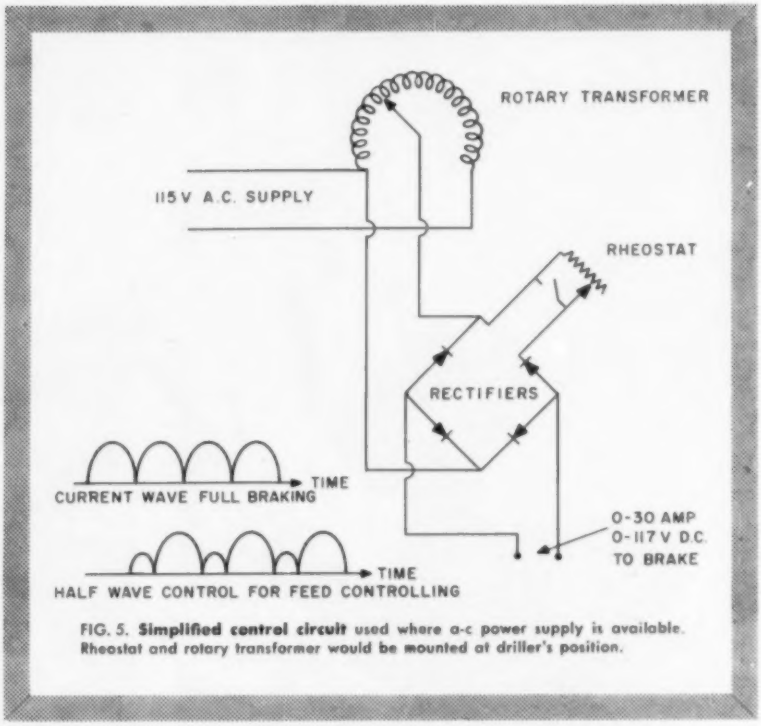



FIG. 5. **Simplified control circuit** used where a-c power supply is available. Rheostat and rotary transformer would be mounted at driller's position.

in the form of a slight loss of power so that proper measures can be taken. It has been estimated that the life of the powder charge in normal operation will be in excess of two years. The iron powder charge is easily replaced by draining and refilling with fresh materials through ports that have been provided.

### Brake Operation

In operation, rotation of the drawworks mechanically distributes the particles along the perifery of the rotor — principally in the grooves and slotted sections of the rotor. Direct current passes through the coils which generate a magnetic field through the housing and rotor. Particles in the chamber collect between the rotor and housing to form a more or less solid cluster between the flat surfaces as shown in Fig. 3. Braking action is believed to be a combination of both friction between the individual particles and through eddy-currents in the rim of the rotor. Intensity or magnitude of the braking action on the rotor is directly proportional to the intensity of magnetic flux in the system.

When the current is shut off, the magnetic field decays rapidly and the particles return to the grooves and are distributed in the system. When not energized, the only losses are those caused by windage friction of the rotor and minor bearing friction.

In essence, the magnetic particle brake is a constant torque machine, whose torque is proportional to the energizing current passing through the coils. Control is made possible through regulation of this current. In use, the driller controls torque by operating a rheostat that in turn regulates current flow. By setting the control on maximum torque, the unit acts as a positive brake, holding the pipe as long as current is passing through the unit. By setting the control at some value less than the weight to be supported by the hook, the unit functions as an auxiliary brake device and also limits the amount of static weight that would be exerted in running-in. The unit may be used in the same manner as a conventional rig brake. By adjusting the controller to suspend the proper amount of drill pipe, a constant weight may be maintained on the bit. In this capacity, the unit makes an excellent drill feed control device.

Control of the device requires direct current which can be obtained from d-c generators or by rectifying alternating current. Rectified a-c provides a pulsating or oscillating d-c current which has been found most beneficial when the unit is used as a drill feed control. Apparently the pulsating d-c induces vibrations in the unit that keep the iron powders agitated and assist in maintaining constant torque characteristics at static and slow drum speeds. Since most rigs are presently equipped with a-c generators, this pul-

sating power is easily obtained. Further work is being done toward the use of pulsating currents in the control system.

While several complex electrical control systems have been used in early designs, the latest control designed for operation on 110-v a-c power consists of only a rotary control transformer, a rectifier bridge and fixed rheostat. The entire unit fits in a box 24 by 18 by 12 in. and can be readily mounted at the drillers position. Its small size will facilitate moving the controls with the drillers console. Driller's controls would consist of a selector switch for braking and drill-feed operations, and a torque control which would operate the rotary transformer.

### Six Sizes Available

At this time only six sizes of brakes ranging from 3000 lb-ft to 100,000 lb-ft have been developed and made available to the industry. Weights range from 900 to 11,000 lb, and with the exception of the two smaller units, are designed for direct connection to the drum shaft. The two small units are designed for chain drive. Maximum excitation power required is 3 kw on the large units and 2 kw on the smaller units. The peak torque which can be delivered can be raised slightly by increasing the powder charge in the unit. This is not recommended due to the resulting increase in no load drag, however. The maximum excitation current used on the largest unit is 30 amps at 117 d-c. Power controls are designed for d-c generators or for alternating current. Current controls in use are operated on three phase and single phase alternating current. Floor controls include a drilling feed control mounted on the right of the driller and a driller's brake control mounted just above the rig brake lever.

It is anticipated that the small size magnetic particle brakes will be of considerable benefit on workover rigs and pulling units. The small size and weight would permit economic installations and the control of weight would be of considerable assistance in running-in and in light drilling operations. Additional benefits will undoubtedly be found in reduced brake maintenance and closer weight control which is essential in many operations inside casing.

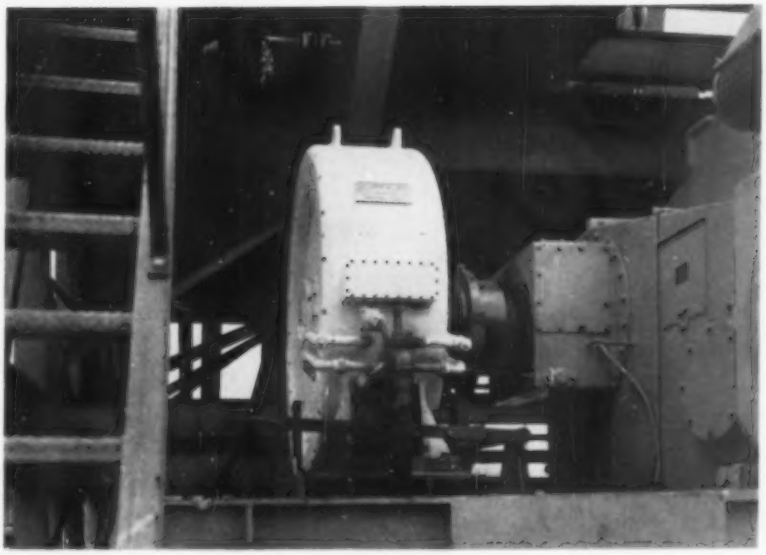


FIG. 6. **Directly coupled to drawworks,** magnetic particle brake is mounted on drawworks frame. Installation is on Sun Oil Company's Rig 15.

### Applications To Date

Only one installation has seen extensive service under field operating conditions to date. This unit was mounted on Sun Oil Company's Rig 15 which was completed in the spring of 1956 and is presently operating in the Gulf Coast area. The magnetic particle brake installed was the first commercial unit built and is capable of holding torque loads up to 100,000 lb-ft.

Rig 15 is a diesel-electric powered rig designed for drilling depths over 20,000 ft. The unit is powered by three 875-hp diesel engines each driving two 502-kw d-c generators. Auxiliary power is provided by two 160-kw diesel engine generator units delivering three-phase alternating current at 440 v. The 440-v power is used to drive various auxiliaries on the rig and is also transformed to 120-v, single-phase current for control of the generators on the main drive engines.

The drawworks used is a double drum unit and is mounted below the floor at truck level. The magnetic particle brake is mounted on the drawworks frame and forms an integral part of the drawworks package during moves. Controls for the drawworks engines, mud pumps and other equipment are mounted on the derrick floor. The magnetic brake is powered by the three-phase a-c current used on other rig auxiliaries. Rectifiers and switch gear for the brake are mounted on a package skid unit and are normally placed near the brake. Drilling feed controls and brake operator are mounted on the console at the driller's position. Cooling water for the unit is taken directly from the rig fresh water system and is returned to the rig tanks.

While the control scheme used on the Sun rig is considered by some to be more complex than required, performance has shown the unit to offer main advantages of reliability and precision control on drill feed settings. The control package transforms the supply voltage to 105 v which is then rectified to 100-v d-c current. Control of power input to the brake is controlled by the use of bias voltages which regulate main power delivered to the brake. Actually, the controls used by the driller operate this bias system which in turn gives him direct precision control on the brake. A selector switch on the drill feed control box permits engaging either the drill feed control or brake control without disturbing the settings on either unit. At the drillers position, the brake control is a single rotary transformer with a lever type operator. The drill feed controls consisted of two variable voltage transformers, one for course adjustment and one for fine adjustment of the amount of weight desired on the bit.

In practice, the drill feed control is used during all drilling operations. In

**TABLE 1. Specifications and Dimensional Data of Magnetic Particle Brake.**

| Depth Rating Feet | Weight Lbs | Excitation Power | GPM Cooling Water | Rated Torque Lbs Ft Max. | Height | Thickness | Shaft Diameter | Width | Center Line Height |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | 11,000 | 3 kw | 100 | 100,000 | 64 | 21 | 8 | 68 | 30 |
| 15,000 | 8,000 | 3 kw | 100 | 60,000 | 55½ | 21 | 7½ | 55 | 28 |
| 10,000 | 5,000 | 2.5 kw | 75 | 30,000 | 43 | 19 | 6 | 42 | 22 |
| 7,500 | 3,500 | 2 kw | 60 | 12,000 | 31 | 20 | 4½ | 30 | 16 |
| 10,000 | 1,300 | 2 kw | 75 | 6,000 | 21⅝ | 16 | 3½ | 21 | 11 |
| 7,500 | 900 | 2 kw | 50 | 3,000 | 17¼ | 13 | 3 | 17 | 9 |

*Courtesy of Baylor Company, Inc.*

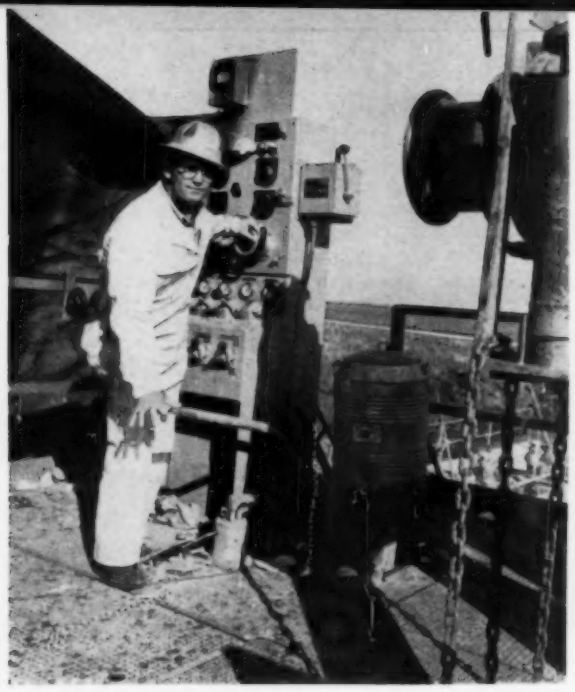


FIG. 7. **Controls for brake** are mounted immediately above the driller's brake. Drill feed control is shown behind the driller.

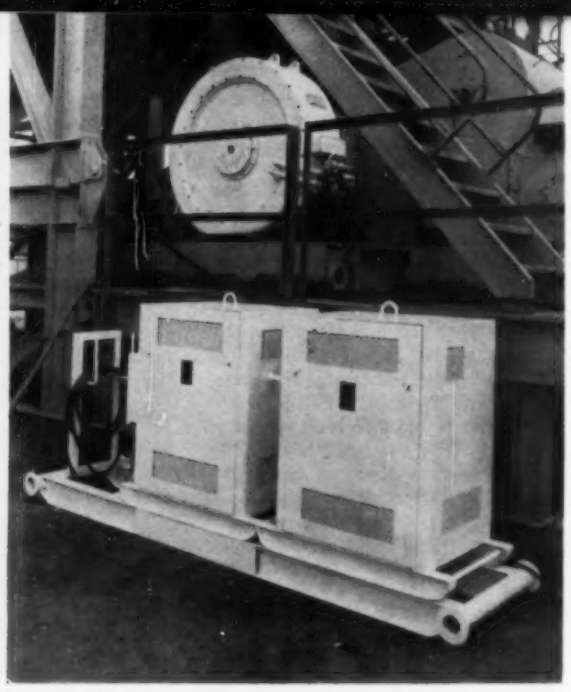


FIG. 8. **Rectifier unit and controls** were mounted in a skid mounted unit on Sun Oil Company Rig 15. Improvements now being made will place this equipment in one small compact box mounted on the floor.

making a trip the unit is switched off while coming out of the hole. In making the trip back in, the control is switched to brake control and the unit is used as a power brake as the pipe is run-in. However, slips are being set using the manual rig brake. Once on bottom, the driller turns the control to "Drill Feed Control" and the unit takes over to maintain the set weight on the bit. If the weight shown on the indicator is too high or low, controls are adjusted until the correct weight is shown on the weight indicator.

At the time the rig was assembled, tests were made to determine the loads that could be held by the magnetic particle brake installed on the rig. The method used consisted of setting the drawworks transmission in low-low, driving the main drum and then stalling the motors with the brake. Maximum torque load delivered by the motors at stall was 120,000 lb-ft which was held by the brake with an excitation voltage of 100 v. This is equivalent to holding a 450,000-lb hook load with eight lines strung in the derrick. Maximum excitation available to the brake was 120 v which would indicate that loads considerably greater than the test load could have been held.

Maximum depth drilled to date with the rig has been 15,000 ft. The maximum weight controlled by the feed control was 12,000 ft of 3½-in. drill pipe and 3000 ft of 2⅞-in. drill pipe while drilling at this depth. Total weight was about 220,000 lb. The heaviest load handled in running-in operations were encountered in setting 9⅝-in. casing to 10,202 ft. Hook load in this case was approximately 479,000 lb. Maximum excitation required was 50 v and only 75 per cent of the powder charge was in the brake at this time. It is anticipated that when fully charged and under full excitation, a load of 1,000,000 lb could have been handled. Due to the additional number of lines strung, the magnetic particle brake was used throughout the running operation in the manner previously indicated in running drill pipe.

## Further Development

From the performance obtained to date, the main brake component appears to be satisfactory. In view of this, future work will be directed primarily toward the development of improved controls and safety devices. One of the main problems encountered is in the power supply system — that of finding suitable rectifiers. Early units used selenuim rectifiers which were bulky and also were sensitive to field conditions. Trial installations are being made at this time to test new silicon junction rectifiers which are considerably smaller and are believed to be more reliable. Successful use of these smaller units with other modifications in the control system will greatly reduce equipment required and facilitate more compact designs.

Among other important developments underway is a fail-safe device that will automatically engage the rig brakes should a power failure occur. This would enable the driller to use the magnetic brake exclusively both in running pipe and when coming out of the hole. It would also permit control of the brakes anywhere on the rig floor and vertually eliminate maintenance on the main rig brakes. Work is being done on a solinoid valve operated air actuated cylinder which would be located in the rig brake linkage. While power is available to the brake system, the valve would be energized to the closed position. Upon electric power failure, the valve would open and admit air to the cylinder, thereby operating the rig brake. Interruption of power at the driller's control would have the same effect, thus enabling the driller to engage the mechanical brake if the situation required it.

With the final development of an adequate fail-safe system, it is apparent that many other controls can be incorporated in the system for improved rig operation. Remote operation, automatic positioning, traveling block limit controls are but a few of the features that could be integrated in the control system.

## Acknowledgment

The author gratefully acknowledges the assistance provided by Ed Goolsbee and Bill Withers of the Sun Oil Company, Beaumont, Texas, and W. B. Baylor of The Baylor Company, Inc., Houston, Texas, for data and information concerning the operation and performance of the magnetic particle brake. ★ ★ ★

**Production Problems — Plus!**

# Gas Production on Utah's Wasatch Plateau

## -A Point of No Returns

Altitude, climate, remote locations, lost circulation problems make hard work for a little company making a big play in the highest natural gas field anywhere

**Over 100 miles of roads** (right) are maintained by Three States Natural Gas for drilling and production maintenance purposes. Hunters, tourists, coal and lumber trucks make good use of the well-built roads.

**Drilling seasons** (below) are short on the Wasatch Plateau, and the first snows of winter send rigs to the low country. This Great Western Drilling Company rig is tearing down, readying for the trip down the long Three State's built roads.

**C. R. Graham**
*Assistant Editor, Drilling and Producing*

DRILLING and production problems and expense rise by the foot in the natural gas producing area of Central Utah. Major developer of the Wasatch Plateau area is Three States Natural Gas Company, Dallas, Texas. The firm is busy turning nearly 300,000 acres of remote mountain country into the basic natural gas reservoir for Salt Lake City.

The 9000-ft high wells in Clear Creek, Joe's Valley and Flat Canyon have been a testing-ground for various methods of drilling, and continue to pose unique situations for the producer. Wells have been rotary-drilled with air, gas, mud, water, and with cable tools.

Most successful method of penetrating the thieving-formations encountered in every well is rotary drilling with fresh water. One Three States engineer qualifies the success of this technique, however, "Water-drilling the wells is not necessarily a solution, but rather a better approach to the problem." Lost circulation has been encountered from surface to total depths of 7000 to 7500 ft. In one case, water disappeared from

# ...One

## BAKER RETAINER PRODUCTION PACKER

PRODUCT NO. 415-D

SINGLE ZONE

PERMANENT-TYPE WELL COMPLETIONS

The Baker Retainer Production Packer has been used in nearly every production application, old or new, and promises to play an even greater role in future production applications.

Because it can also be used successfully as a squeeze tool, it is used in a variety of supplemental applications (such as testing, acidizing, formation fracturing, squeeze cementing, etc.) that might be required during the completion or work-over phase of a well. That is why the Baker Retainer Production Packer has been frequently referred to as the "universal" packer, because it is truly the *one* packer that can be used *for all* production and many supplemental applications.

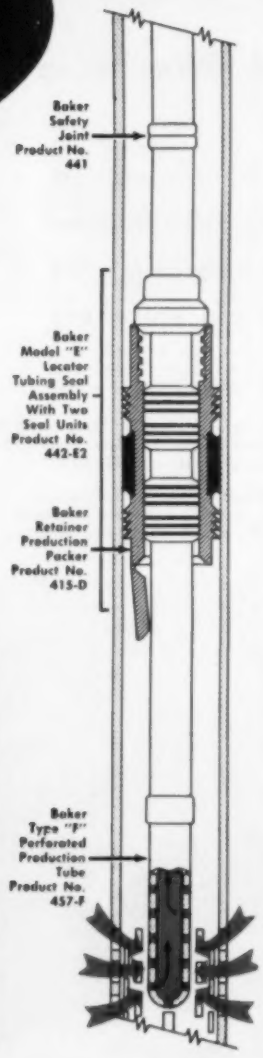
### FEATURES

**Can be run and set with the speed and accuracy of wire line, as well as on tubing or drill pipe.**

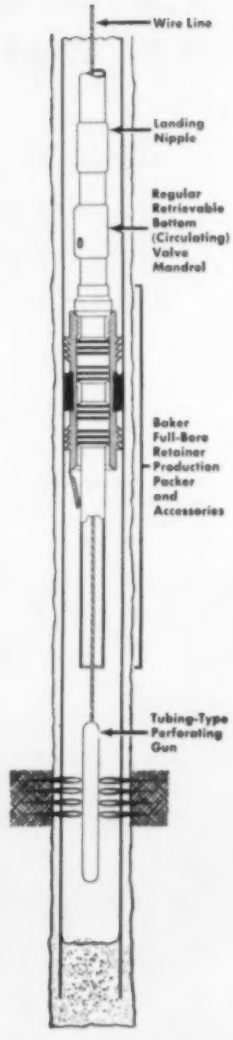
**Holds any pressure from either above or below that is safe for the casing, even under temperatures in excess of 300°F.**

**Pack-off is independent of set-down weight or tension. Tubing string is free; just pick up (or unlatch and pick up) to remove it.**

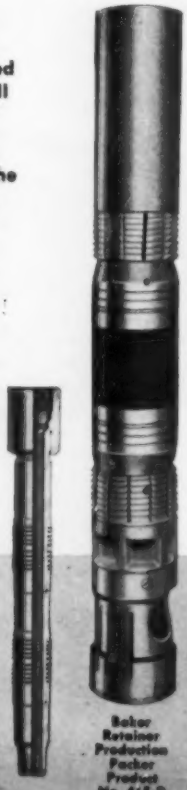
**When tubing is removed, flapper valve closes to isolate zone below packer.**


Baker Safety Joint Product No. 441
Baker Model "E" Locator Tubing Seal Assembly With Two Seal Units Product No. 442-E2
Baker Retainer Production Packer Product No. 415-D
Baker Type "F" Perforated Production Tube Product No. 457-F

Illustrates Packer set in casing with Locator Tubing Seal Assembly and Production Tube installed for single zone production.


Wire Line
Landing Nipple
Regular Retrievable Bottom (Circulating) Valve Mandrel
Baker Full-Bore Retainer Production Packer and Accessories
Tubing-Type Perforating Gun

Illustrates typical Permanent-Type Well Completion Hook-Up showing perforating operation through and below the Packer.



Baker Locator Tubing Seal Assembly Product No. 442-E2

Baker Retainer Production Packer Product No. 415-D

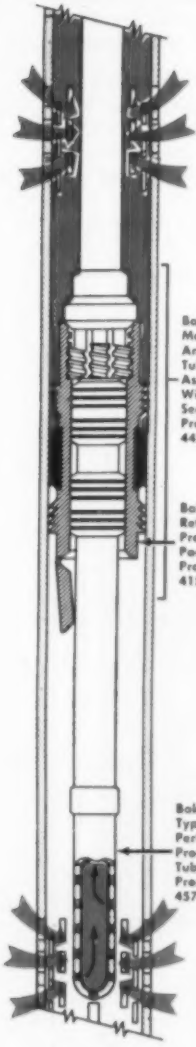
**Successfully holds high pressures from above or below**

...at shallow or record depths
*even under temperatures in excess of 300°F.*

# for all

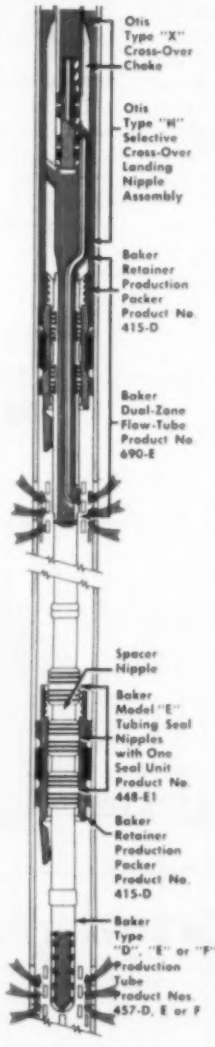
## DUAL ZONE

### SINGLE PACKER


Baker Model "E" Anchor Tubing Seal Assembly With Two Seal Units Product No. 443-E2
Baker Retainer Production Packer Product No. 415-D
Baker Type "P" Perforated Production Tube Product No. 457-P

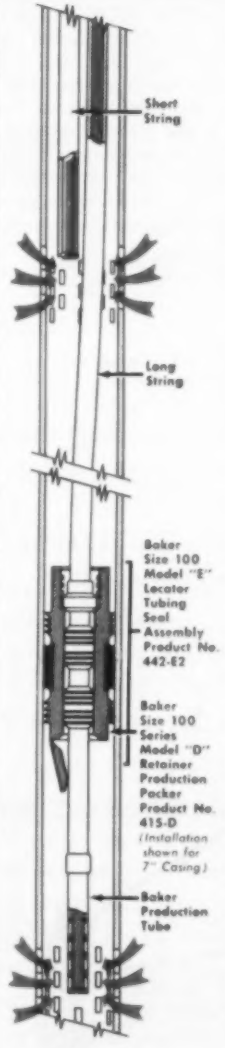
Illustrates Packer set in casing, with anchored production string for dual zone production. Tubing can be released from packer by rotating to right.

### SELECTIVE CROSS-OVER


Otis Type "X" Cross-Over Choke
Otis Type "H" Selective Cross-Over Landing Nipple Assembly
Baker Retainer Production Packer Product No. 415-D
Baker Dual-Zone Flow-Tube Product No. 690-E
Spacer Nipple
Baker Model "E" Tubing Seal Nipples with One Seal Unit Product No. 448-E1
Baker Retainer Production Packer Product No. 415-D
Baker Type "D", "E" or "F" Production Tube Product Nos. 457-D, E or F

Illustrates selective two packer dual zone production hook-up (Baker-Otis) with Cross-over Choke installed. Flow pattern can be switched with Parallel Flow Choke.

### PARALLEL STRING


Short String
Long String
Baker Size 100 Model "E" Locator Tubing Seal Assembly Product No. 442-E2
Baker Size 100 Series Model "D" Retainer Production Packer Product No. 415-D (Installation shown for 7" Casing)
Baker Production Tube

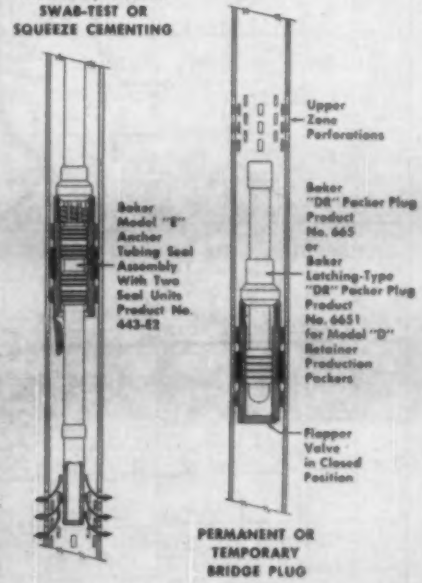
Illustrates simplest type of parallel string installation. Other installations involving two packers with full-opening tubing running through and below lower packer available.

## SUPPLEMENTAL APPLICATIONS

**WATER OR GAS INJECTION**

The Baker Retainer Production Packer contains features that permit it to be used as a squeeze or testing tool as well as a temporary or permanent bridge plug. It is thus used in a variety of supplemental applications such as gas or water injection, testing, fracturing, acidizing, etc., that may be required either during the completion phase of a well or during a later phase.

**FRACTURE, ACIDIZE SWAB-TEST OR SQUEEZE CEMENTING**


Baker Model "E" Anchor Tubing Seal Assembly With Two Seal Units Product No. 443-E2
Upper Zone Perforations
Baker "DB" Packer Plug Product No. 665 or Baker Latching-Type "DB" Packer Plug Product No. 6651 for Model "D" Retainer Production Packers
Flapper Valve in Closed Position

**PERMANENT OR TEMPORARY BRIDGE PLUG**

*Send for complete information*

*A new 72 page catalog supplement is now available on the Baker Retainer Production Packer and its many features and applications. Write or ask your Baker Representative for Baker Catalog Supplement No. 502.*

# BAKER

**OIL TOOLS, INC.**

HOUSTON • LOS ANGELES • NEW YORK

a surface reserve pit when the bottom opened up. This is just one of the problems.

### Short Seasons

Drilling seasons are short, usually opening in the latter part of May or early June and ending about November 1. Even in this time, trouble is experienced in keeping water lines ice free. As the 1956 drilling season closed, one rig was left on location, where the well was unfinished for lack of drilling water. A second drilling rig was moved out over snow-covered company-built roads.

Most wells have a surface elevation of 8000 to 9000 ft, with some nearly 10,000 ft high. It has been estimated that these altitudes cut operating efficiency of both men and equipment 30 per cent. Locations are on the mountain slopes, usually on a plot of ground blasted from the mountainside. Access to these "shelf" locations is a major consideration. Three States has built and maintains over 100 miles of roads to the wells. The company has turned the area's Forest Service trails into wide roads with maximum 8 to 15 per cent grades capable of supporting 50-ton loads. Average cost per mile of company road is about $4000.

### Discovery by Three States

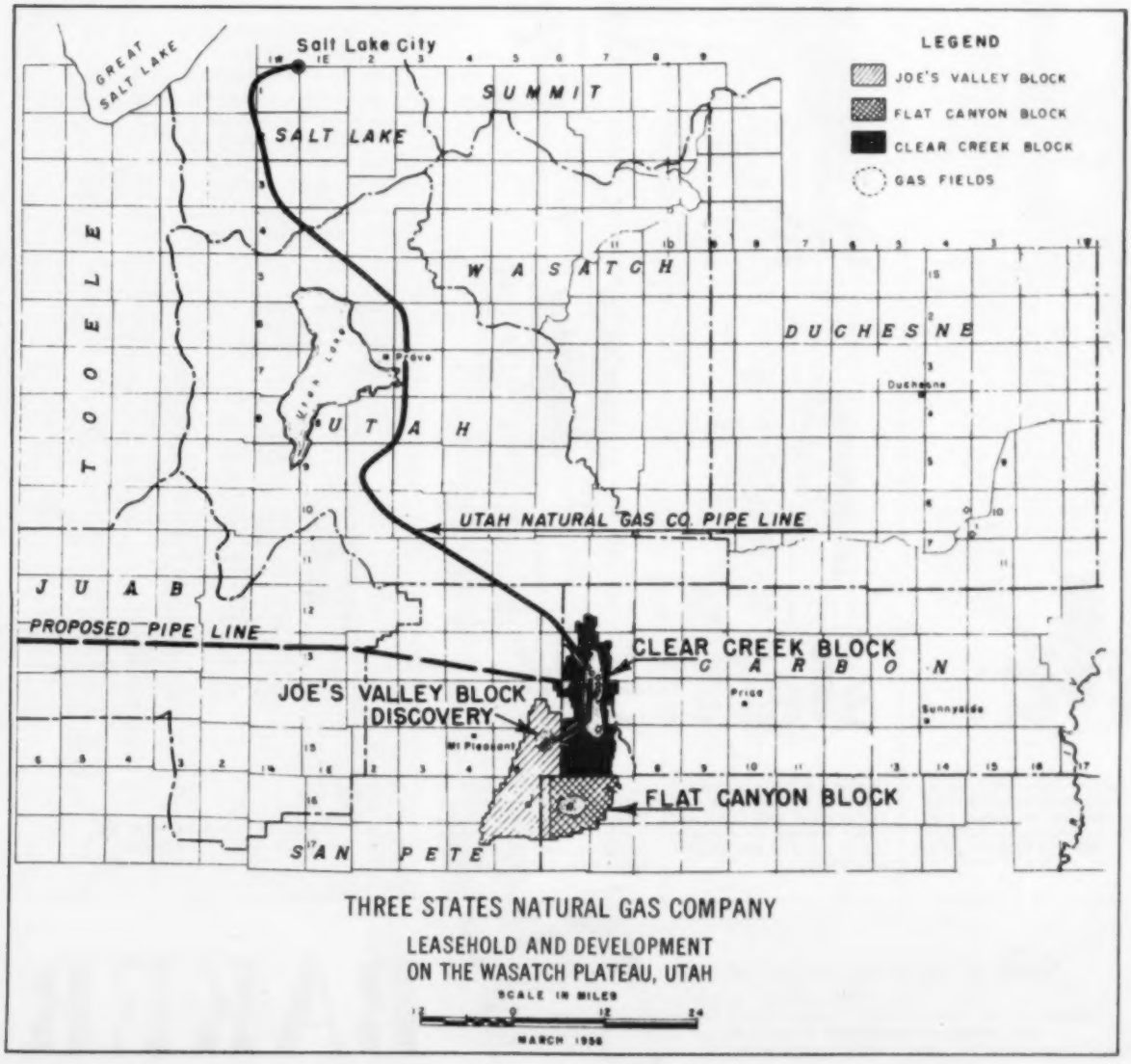
Three States Natural Gas entered the area in 1951 and made the initial discovery in Clear Creek in Emery County. Since that time, over 33 billion cubic feet of gas has been produced by the company from the Clear Creek field. In the summer of 1953, exploratory drilling began on the Joe's Valley structure at the C. K. Steiner No. 1. This well, with an elevation of 10,294 ft, was abandoned because of mechanical difficulties. The second wildcat at Joe's Valley was spudded in July, 1954. It was drilled to a depth of 9520 ft. Non-commercial gas was encountered and operations were suspended.

At the same time, Joe's Valley 1-X, a direct offset to the original wildcat, was spudded. This well was successfully completed in November, 1955 with an absolute open-flow capacity of 7,400,000 cu ft of gas per day and a shut-in casing pressure of 1373 psi. The company estimates that its Joe's Valley wells will be more productive than those in its Clear Creek development.

### Ferron and Dakota Productive

Productive formations on the Wasatch Plateau, in both the Joe's Valley and Clear Creek fields, are the Ferron sand, with seven members, and the Dakota.

Only one of the Three States' wells



acidize and fracture
in
one
operation

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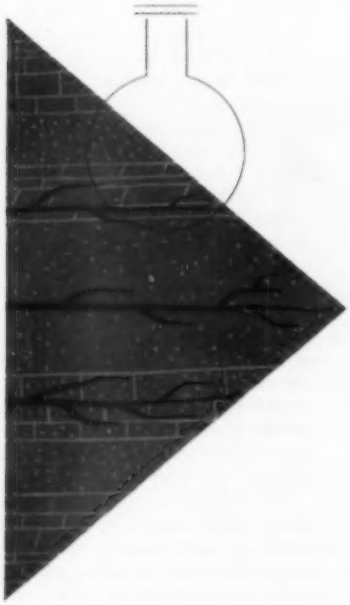
HALLIBURTON'S

*Acidfrac*

**TWO-IN-ONE PROCESS**

When limestone is present, chemical and fracturing treatments are combined in Halliburton's Acidfrac process...a tailor-made acid-in-oil emulsion engineered to increase your oil and gas production.



*FARTHER EFFECTIVE PENETRATION*

Acidfrac's delayed acid action provides deeper chemical penetration . . . can be forced farther into the reservoir for extended effectiveness. Acidfrac's emulsion breaks clean too . . . with reaction, time and temperature.

*COMBINATION TREATMENT*

Acidfrac emulsion is an efficient sand carrier. The combined chemical and mechanical fracturing action team up to give you beneficial results in many cases where conventional acid or fracturing treatments fail.

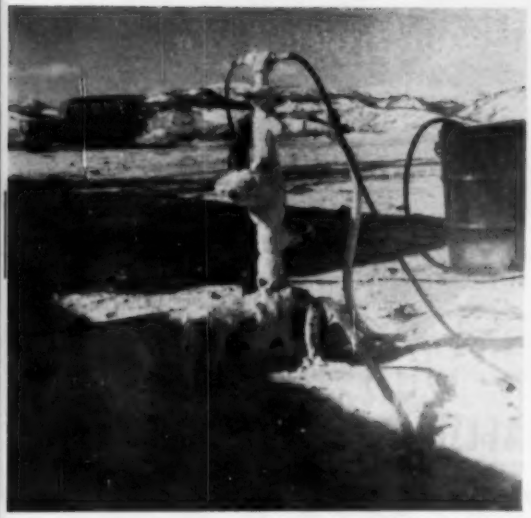
To aid in reviving recovery from limestone, dolomite or limey sand formations, use Halliburton's double-acting Acidfrac process. Call the local or district office or write the Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

Ask for "Elements of Hydraulic Fracturing" brochure.

**HALLIBURTON**

**FRACTURING SERVICES**

251 SERVICE CENTERS—
JUST MINUTES AWAY FROM ANY RIG



**Freezing lines** and equipment are a constant hazard. This snow-covered fuel manifold is just one example. An extra man is used on the drilling crew to keep long water lines flowing and ice free.

**Producing gas wells,** such as this one, are flush with the ground, with all wellhead equipment recessed in an 8-ft deep concrete box. Metering equipment is in the house in the background.

is dually completed. This is the Joe's Valley No. 3; all other wells produce from the Ferron only. Only limited production with lower potentials has been recovered from the Dakota.

The Ferron sandstone is a 500-ft thick section of interbedded sandstones and shales, and is of the Cretaceous age. Of the seven Ferron zones, only the seventh, or bottom member, is present in all wells. Usually two or three zones are found in each well. Water underlies the gas in the seventh sand. To produce the Ferron, casing is set on top of the formation and the well is drilled in with gas and completed open hole, allowing the gas to enter from all productive zones. Tubing is set on bottom for the purpose of producing the water in the hole. If water is allowed to remain in the producing formation, bentonic clays will swell to hamper maximum gas production.

Depth of the Ferron ranges from 4000 to 7800 ft, depending on the surface location of the wells on the mountain slopes. The Dakota is topped about 400 ft below the base of the Ferron.

### Lost Circulation

Formations above the Ferron are generally bentonic shales, sandstone and coal in nature. All are highly porous, providing drillers with lost circulation problems. Little fluid returns are expected after surface casing is set at about 550 ft, and in one or two cases lost circulation occurred before surface pipe was in the hole.

Natural gas produced from both the Dakota and the Ferron is very dry, producing no condensate. Water content of the gas is about 8 gal per Mcf. Heat content is 995 Btu per Mcf. The gas is taken by Utah Natural Gas Company pipe line, dehydrated at a central station on the plateau and sent on to Salt Lake City.

Until 1954, Three States had operated its own rigs and has kept as many as five rigs active in the area at one time. Present drilling operations are contracted by Great Western Drilling Company, Midland, Texas.

Rotary drilling with mud has proved unsuccessful, as no quantity of lost circulation materials seem to fill the porous formations. Green coal, burlap bags, wood chips, cottonseed hulls and gel flakes have been used. No weighting material was added to the mud system. Several wells, however, have been mud drilled and completed as producers. The Utah Fuel No. 10 and the Utah Fuel No. 2 were mud drilled. In Utah Fuel No. 10, the well was completely drilled with mud, with casing set through the Ferron. Mud acid was used to clean the well, and was completed for an open-flow potential of 10,700,000 cut ft per day. On the Utah Fuel No. 2, casing was set into the Ferron sand, then later deepened through the Ferron and a liner cemented in place. Sands were selectively perforated and treated with mud acid. Although this well was completed with a potential of 22,300,000 cu ft per day open flow, much fluid was lost to the producing zone. For this reason, continuance of this method was not considered feasible, for fear of sealing the zone.

### Cable Tools

Cable tools have since been used in an attempt to solve Three State's difficulties found in mud drilling. In Flat Canyon, the Kearns No. 2 was drilled from top to bottom with cable tools. This well, with a surface elevation of 8970 ft, was drilled to a total depth of 6379 ft. Water, standing continually in the hole, made drilling a slow process. The well was spudded on July 13, 1953, drilled through the winter and completed the following August — about 370 days over the hole.

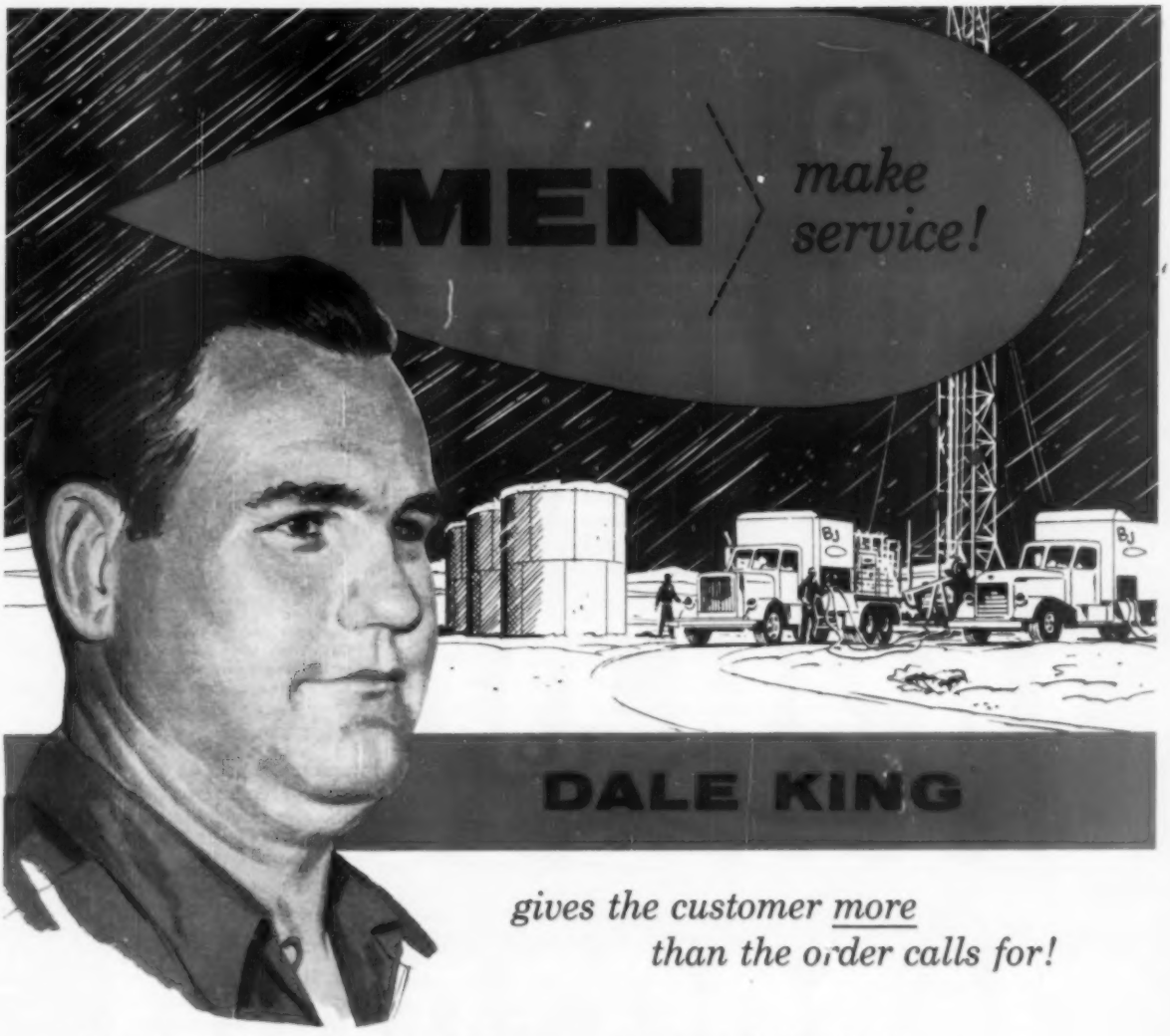
The Joe's Valley No. 1-X was drilled to 4184 ft with cable tools, where an 8⅝-in. intermediate casing string was set. From that point to 7090 ft, the top of the Ferron, the 1-X was rotary drilled with mud as circulating media; at this point 7-in. casing was set and the well was drilled in with air to a total depth of 7262 ft. Drilling stopped at this point because air compressors were unable to build sufficient pressure to open the float valve.

The formation water that had rendered cable tool drilling unsuccessful comes primarily from the Emery, a highly fractured, extremely hard sandstone carrying plenty of water. Hole deviation problems increase considerably in drilling the Emery.

Diesel oil and oil emulsion mud have been used to deepen one of the Wasatch Plateau wells. Because of the cost of this method, increased by the large quantity of fluid lost to the thieving formations, this has been abandoned.

### Air and Gas Drilling

Air and gas drilling has proved partially successful, and is now used to drill into the producing formations. The sandstones and shales found here have only about 10 per cent porosity and

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the entire section is highly bentonitic. It is felt that any water or fluid would hamper gas production. Any water or drilling fluid used above the Ferron must be blown from the hole before entering the productive zone. At this point the well is cased and drilling-in is done with gas. Drilling weight on the bit in productive formation is decreased from about 20,000 to 5000 lb. Bits used in the productive formations average about 70 ft of hole.

### Water Drilling

Fresh water drilling has proved the most successful method of drilling the Clear Creek, Flat Canyon and Joe's Valley wells. Fresh water is pumped directly from reserve tanks into the well. Water, although less expensive than other rotary media, can be a big problem. A well now partially drilled, currently shut down for the winter, obtains water from a source seven miles away and is boosted uphill about 2000 ft. This well is the Joe's Valley No. 5. As in all other wells, keeping water lines free from ice is a big job. An extra man is added to the regular drilling complement to keep the water moving. In this operation, duplex reciprocating pumps are used at either one or two points along the line.

Water is used in drilling primarily for bit lubrication and to expel cuttings from the immediate cutting area, rather than for the return of cuttings to the surface. Little returns are expected as most water and cuttings enter fissures and fractures in the formation. Formations are picked by changes in drilling speed recorded on the drilling time log. Seldom is the hole filled with water, the fluid level usually being about 1000 ft from the surface.

All Utah water belongs to someone. Although Three States may create reservoirs at the end of a canyon, or drill a well, water fees must be paid to the particular irrigation company having jurisdiction over the watershed in that area.

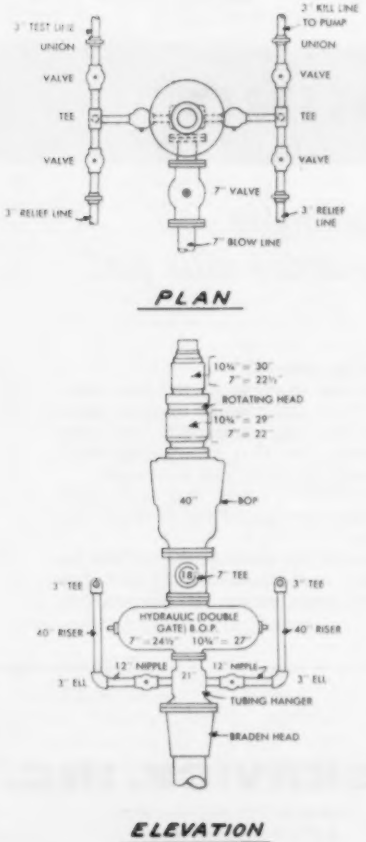
Drilling with water has proved successful for several reasons. In wells where comparison could be made with mud drilled wells, water wells proved more economical in bit, drilling time, and additive expense.

Comparing the bit records of the Joe's Valley No. 3 (drilled to 6696 ft with water), using 36 bits; the water-drilled Utah Fuel A-1 that used 35 bits to 5911 ft; the mud drilled Utah Fuel No. 10, using 58 bits to 4620 ft, and the Utah State 1256 No. 1 that used 56 bits in mud drilling to 4850 ft, an apparent difference in bit life is seen.

The Joe's Valley No. 3 well was drilled to the top of the Ferron at 6696 ft with water. At this point the well was cased and was mud drilled to completion in the Dakota at a depth of 7611 ft. As many bits were used in drilling the Ferron and Dakota as in all drilling above. Time drilling the initial 6700 ft was 30 days; time drilling and completing the well for the remaining 800 ft was almost 60 days. In the mud drilled section, some 160,000 lb of bentonite was consumed by the hole — in addition to large amounts of mud additives.

### Long Line of Supply

Most wells are completed naturally, although nitroglycerine has been used to bring in some. Casing and surface pipe is set by an oil well cementing company that keeps a truck at "nearby" Price — 40 to 60 miles away from most wells. Electric logging equipment, other supplies and services must come from oil centers in Grand Junction, Colorado, Farmington, New Mexico, or from points on the West Coast. On at least one occasion, the logging truck came from Montana. Because of the long supply lines, weather conditions and the remote well locations, late arrival of service trucks and equipment is the rule rather than the exception.




**Blowout control equipment** required by Three States rises nearly 14 ft from braden head to rotating head, necessitating high substructures and deep cellars. Although drilling for natural gas in any area poses certain problems, blowout control here is of particular importance.

**Gas line** from Three State's wells finds a rugged path through the mountains to Salt Lake City outlets. Utah Natural Gas Company, owner of the pipe lines, maintains a dehydrator station on the plateau at an altitude over 10,000 ft.

### Blowout Control

Because of the blowout hazard, Three States has stringent regulations for its blowout control equipment. Overall height of this equipment is 13 ft, 8½ in. Above a 21-in. tubing hanger is a hydraulic, double gate, blowout preventer, mounted by a 7-in. gas drilling tee. This is fitted with a 7-in. valve so that flow into the blow line may be closed. Above the tee is a hydraulically-actuated stripper type preventer. Above this is a 10¾-in. rotating head.

### Undercover Work

On completion of a well, the large drilling cellar, dug to accommodate the blowout equipment, is cemented in the form of an 8 ft deep, 6 ft square box. In this box are the Christmas tree and wellhead equipment. This is covered with steel plate flush with the ground, to safeguard the well from rock avalanche or snowslide, which could occur on the steep mountain slopes.

Other companies are now active in the area, although much of the land is leased to Three States. During the 1956-57 winter, Three State's wells will supply Salt Lake City with more than 55,000,000 cu ft of gas daily. Further exploration of the Joe's Valley field is expected to continue next summer, with two new wells scheduled for immediate drilling. ★ ★ ★

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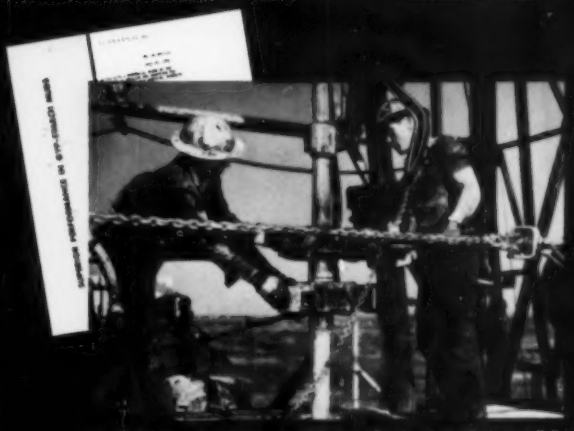

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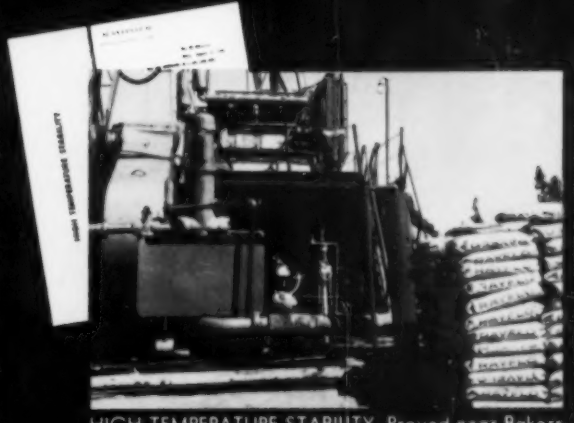

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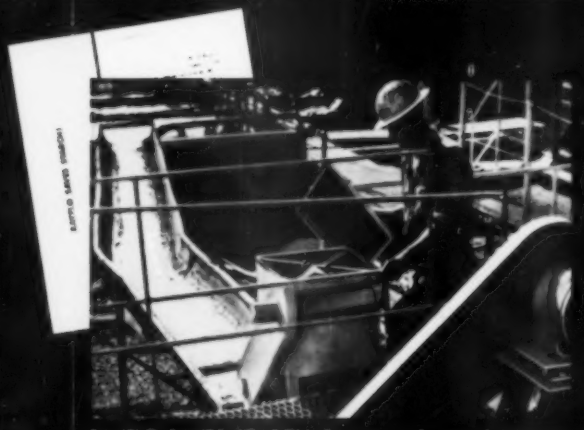

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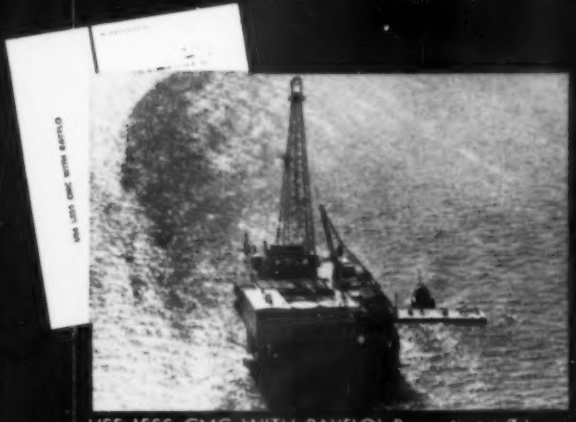

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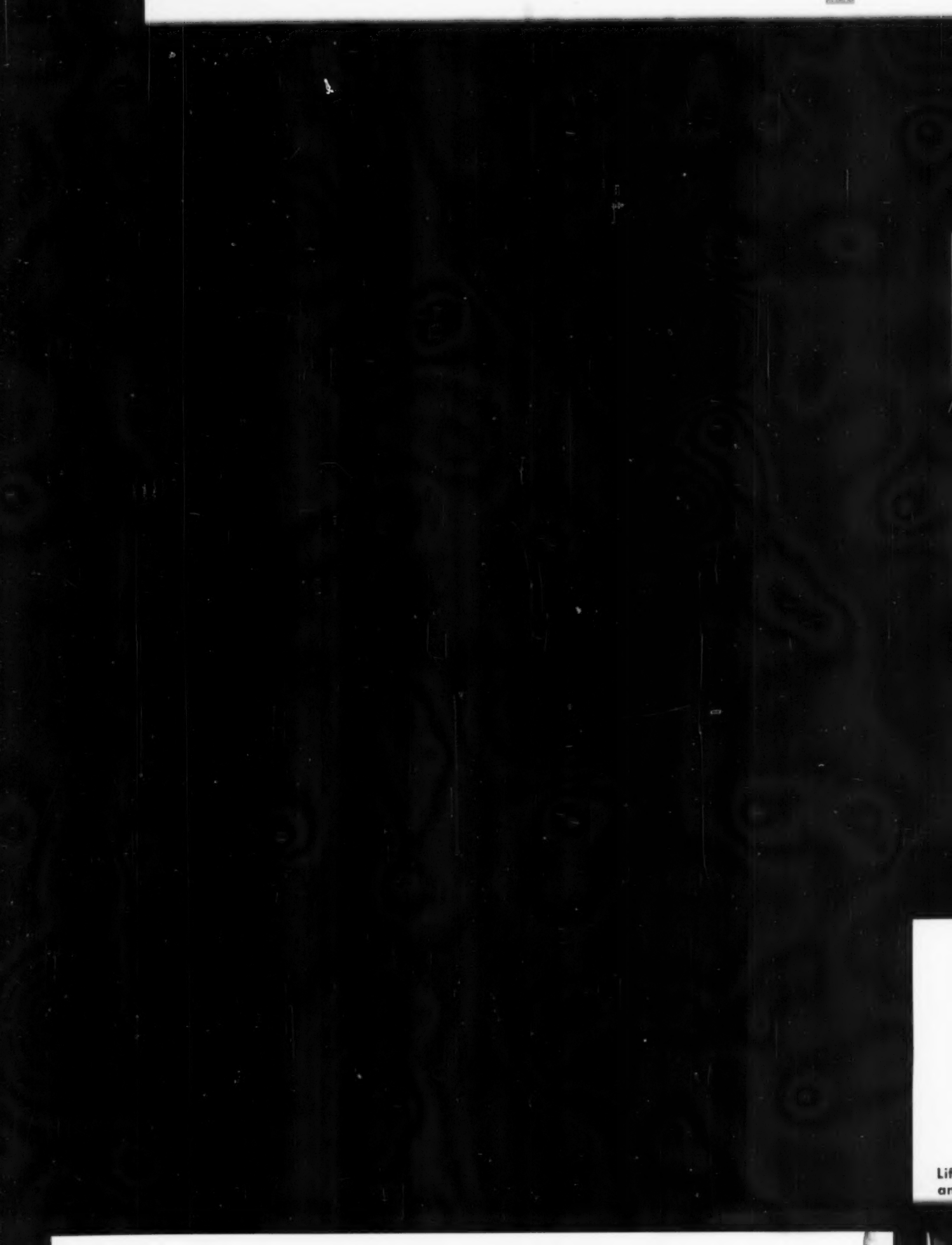

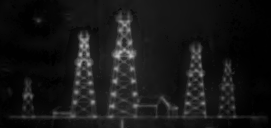

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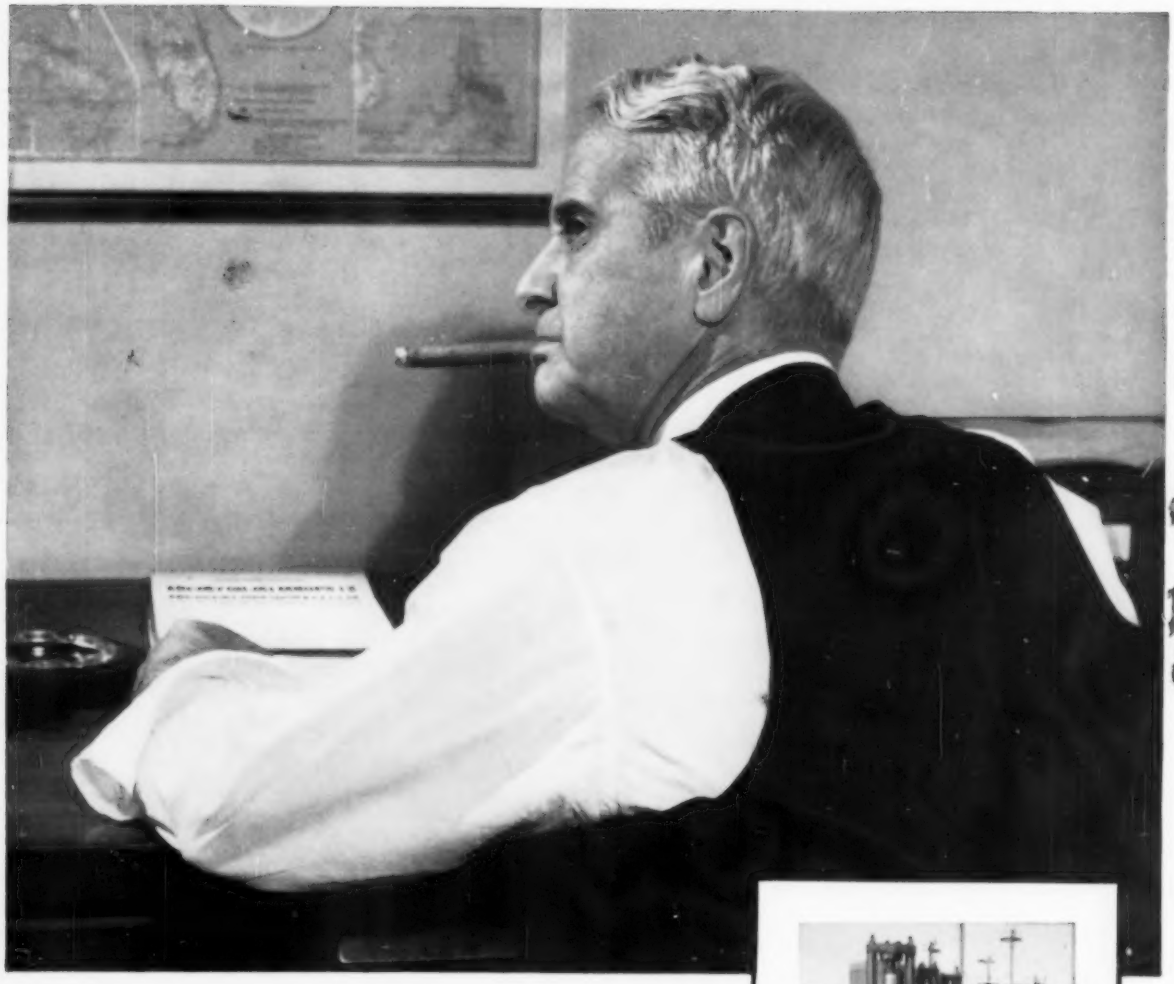

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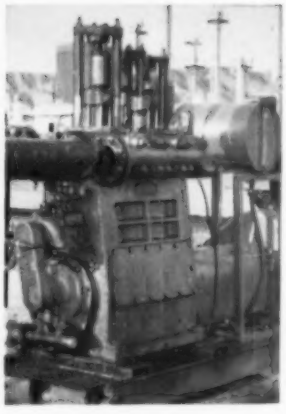

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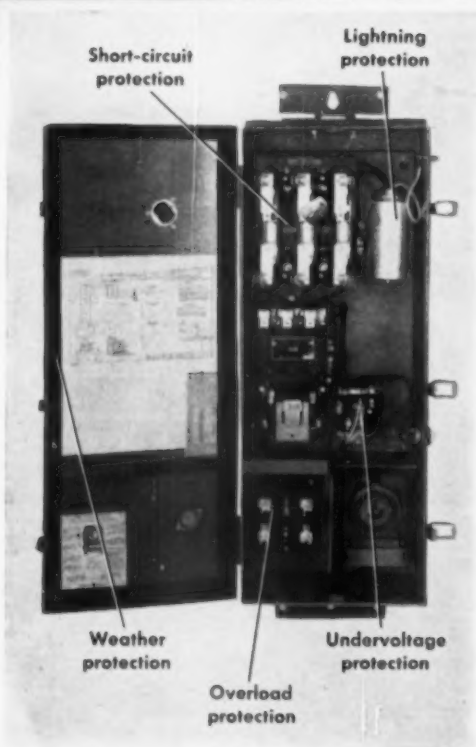


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**Latest development in jet perforating**

# NEW SHAPED CHARGE Packs Bigger Wallop

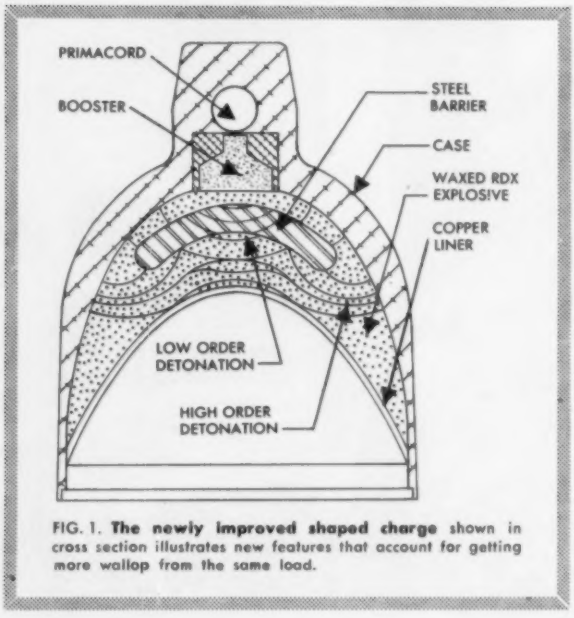


FIG. 1. **The newly improved shaped charge** shown in cross section illustrates new features that account for getting more wallop from the same load.

**In a 4-in. gun, same 19-gram load . . .**

- *Increases hole volume three times*
- *Enlarges entrance hole four times*
- *Eliminates carrott slug*
- *Increases penetration slightly*

**J. E. Kastrop**
*Editor, Drilling and Producing*

EXTENSIVE research in shaped charges has led the way to a practical adaptation of detonation theory to increase the wallop in jet perforating. This has been accomplished by controlling the detonation front within the same type and amount (19 grams) of wax-coated RDX explosive to superimpose a high order and a low order detonation over the spherical portion of the newly-designed copper liner. Surface tests into cement targets indicate that the hole size of the perforation has been enlarged three times or 200 per cent over the volume of the hole made by conventional shaped charges. Size of the entrance hole in the casing was increased four times in size, or twice the diameter in some tests. While there was some slight increase in penetration, there was no appreciable carrott slug remaining in the hole.

The new shaped charge, called the Dyna-Jet, is about the same size as its conventional predecessor for 4-in. perforating guns. It is the result of basic research on shaped charges at the Poulter Laboratories of Stanford Research Institute at Menlo Park, California. Practical application of the research findings were made by the Jet Research Center near Arlington, Texas, where the new shaped charges were designed and made. At the present time, the new shaped charge is available only for the 4-in. gun, and is comparable in cost with present shaped charges for this size perforator.

**Basic idea of shaped charge.** Much has been published about the basic principle behind the shaped charge. In conventional shaped charge design for jet perforating, the explosive is usually contained in a metal case and the front of the molded explosive is depressed in the shape of a cone supported by a thin copper liner. Generally accepted theory is that the metal cone is disintegrated into particles that converge at the axis of the cone to form the jet stream. Metal from the cone's apex forms the forward end of the jet while metal from the inner surface of the cone's skirt forms the after end of the stream. Force of the leading particles starts the digging or punching action, followed by the remaining particles in the rest of the jet stream, thereby penetrating deeper and deeper. The mass distribution of metal throughout the jet stream has a critical effect upon the penetration and configuration of the perforated hole.

**Improving jet charges.** To improve conventional jet perforating without making the charges bigger was a complex problem. This was the job of research under the auspices of the Jet Research Center which functions as a service organization to all licensed jet perforating service companies. Since the depth of penetration of conventional jet charges was satisfactory, there were three primary avenues of improvement. It was deemed desirable to enlarge the entrance hole in the casing, to provide the maximum diameter hole all the way to bottom (and thereby, maximum hole volume), and eliminate the carrott or slug.

**Research aids.** The flash X-ray camera made it possible to study the jet stream. This unique device is capable of taking ultra-high speed photos called radiographs. It brought about a tremendous reduction in the research effort and played an important role in the new development.

**Velocity of jet.** The conventional tapered hole normally produced by

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FIG. 2. **Test shooting setup** for comparing perforating results of new shaped charge with that of the conventional jet charge.

FIG. 3. **Comparative perforating results** show hole punched in target at left by new shaped charge to be three times volume of conventionally jet perforated hole in target at right. Note relative size of entrance hole in both targets.

FIG. 4. **Jet Research Center officials** inspect both targets. At left is JRC president, Blake M. Caldwell, with director of research, R. L. Robinson, right.

standard shaped charges results from a uniform distribution of metal particles in the jet stream combined with the normal velocity gradient of these particles. To produce a larger entrance hole, velocity of metal particles at the tip of the jet would have to be extremely high, or the mass of metal particles at the jet tip would have to be increased.

Research of current shaped charges indicated that the forward tip of the jet stream was approaching the theoretical maximum that could be obtained. The other alternative was to increase the mass of metal in the jet tip.

**The new shaped charge.** Fig. 1 is a cross-section of the new and more powerful shaped charge. In consists of a metal case, an eye or hole through which to insert the primacord, a booster charge, a steel barrier, wax-coated RDX explosive press-molded to shape, and a metal liner. It is quite similar in size to conventional shaped charges for the 4-in. perforating gun, and contains the same amount of explosive . . . 19 grams.

**Booster charge.** The booster charge is not packed as dense as the primary charge. The less-dense booster charge is more sensitive to shock than the main charge, but the more dense the explosive is compacted, the more powerful it is when detonated. Therefore, the primacord detonates the loosely packed booster charge that provides efficient and certain detonation of the main densely packed explosive.

**Steel barrier.** Application of the steel barrier and the shape of the metal liner proved to be the two critical features that account for the improved shaped charge. In conventional shaped charges, the cone depression causes the metal liner particles to converge at the axis of the cone to produce an additive effect so far as resultant energy of the jet stream is concerned. It is known that when a low order detonation is superimposed upon a high order detonation, a multiple effect rather than an additive one results.

To produce a high and a low order detonation within the explosive, a steel barrier was placed in the press-molded explosive as shown in Fig. 1. Both orders of detonation are indicated in this diagram as they are superimposed over the spherical portion of the liner. This multiplication of energy provides the higher velocity necessary in the greater metal mass of the spherical portion of the liner that is necessary to produce a large entrance hole and a perforation of greater and uniform volume.

Development of the detonation front is indicated schematically in Fig. 1. The detonation front passing through the steel barrier is slowed down to one of a low order, while the detonation within the explosive around the barrier remains one of a high order. Geometry of the case, the steel barrier and the press-molded explosive cause the low and the high order detonations to be superimposed over the spherical por-

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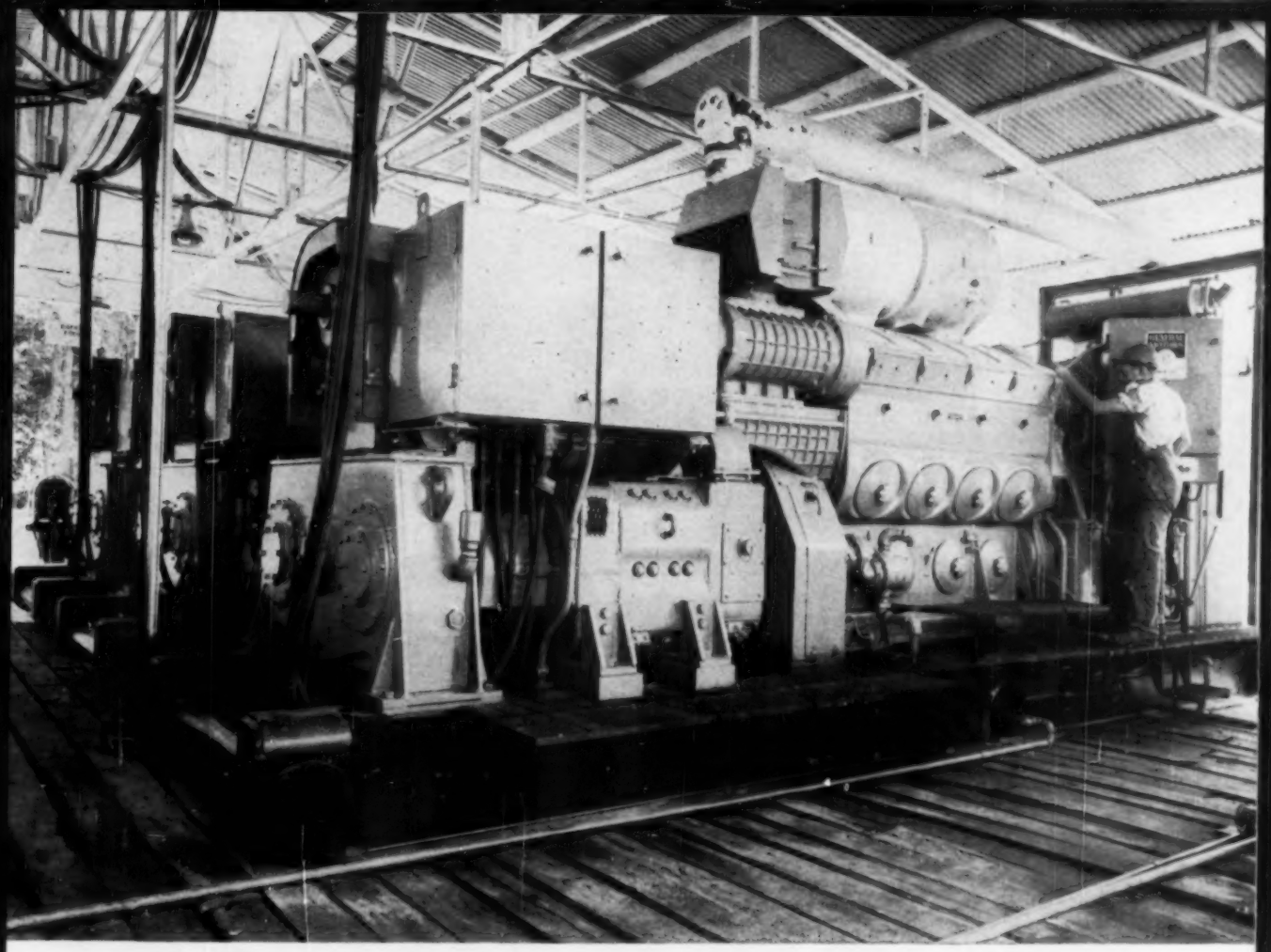
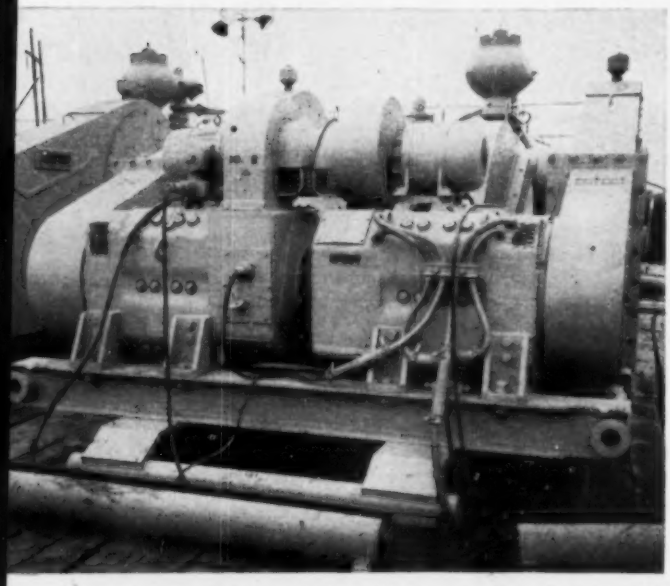
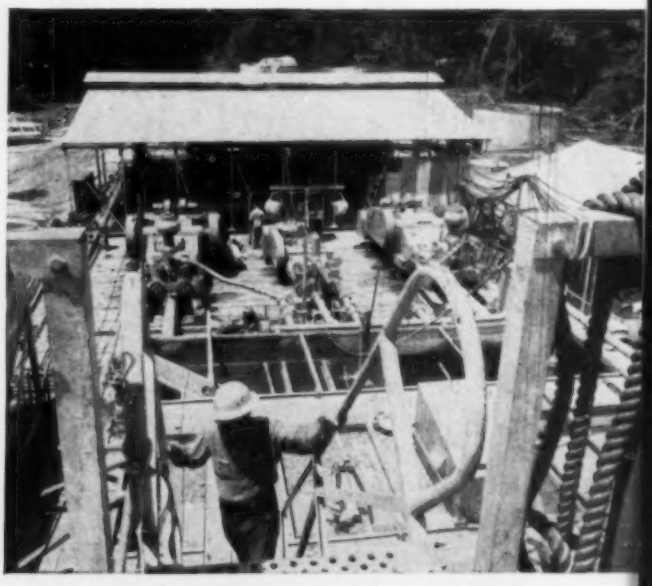


Three skid-mounted Electro-Motive Diesel generating sets rated at 875-hp. supply power for motor driven pumps, rotary table and draw works. Each unit is complete with two 500-kw generators, controls and cooling system.



Drive motors are 625-hp. direct current type for smooth, rapid acceleration of loads and positive control of speed and torque. Each main pump has two 625-hp. motors for a total horsepower rating of 1,250.



Simple, flexible conductors connect generating sets to drive motors, allowing complete flexibility of arrangement. Rig-up time is reduced considerably because components are located to fit the site.

# It's Diesel-Electric for Shell on Cote Blanche Island

## Portable, rapid-setup Electro-Motive Power choice for big rig in rugged Louisiana swamp

To work the swampy Cote Blanche Island field, Shell Oil Company faced two opposing requirements for their Rig 11. First, the rig had to be big, with power to drill over 18,000 feet. And second, it had to be easily portable to enable movement over primitive roads.

Shell's decision to use Diesel-Electric was influenced by the fact that this type power permits gathering almost all equipment into easy-handling, skid-mounted packages. In spite of rough terrain, rig-up can be completed in record time.

Electric conductors running from generating units to drive motors provide flexibility in locating equipment to suit conditions. This design avoids clutter, reduces rig-up and rig-down time and makes a big rig far more economical to move. Also, with few modifications, equipment can be adapted for offshore drilling.

Three Electro-Motive SR-8, 875-hp. Diesel generating units driving nine 625-hp. d.c. motors provide the drilling power for Rig 11. Its first hole is scheduled for 18,500 feet, using a 14,000 foot, 9⅝ in. protective string. It takes big power to drill below the overhang of the salt dome in this area, and this rig has it.

Electro-Motive Power is adaptable to many different types of drilling devices on land or water. For complete details on how it might fit your own particular requirements, get in touch with your Electro-Motive representative.

**ELECTRO-MOTIVE DIVISION · GENERAL MOTORS**

**LA GRANGE, ILLINOIS** *In Canada:* General Motors Diesel Limited, London, Ontario

**Petroleum industry sales offices:** Tulsa, Oklahoma; Houston, Texas; Dallas, Texas; Morgan City, Louisiana; Pasadena, California.

Driller's control is located next to draw works. From a central position, driller has complete control of Diesel-Electric equipment, including engine speed, pumps, hoist, rotary table and safety shutdown.

Derrick on Rig 11 is a big one—147 feet. It was modified for platform drilling, but can be extended to 189 feet. In spite of size, the rig is highly portable. Skid-mounted equipment gathers into easy-handling packages.

tion of the metal liner which makes up the forward portion of the jet stream. Shape of the metal liner was redesigned to produce the jet stream necessary to achieve the desirable characteristics. Instead of a true cone with curved apex as in standard jet charges, shape of the metal liner in the new jet charge is more nearly a portion of an ellipse.

**Testing the new charge.** Although field performance of the new shaped charge is yet to be evaluated, it has been fully tested in the laboratory utilizing standard procedures. The target for comparative tests between the conventional and improved shaped charge for 4-in. guns was made by welding a section of 5½-in. N-80, 17-lb per ft casing to a 16-in. section of the same 5½-in. pipe. This 16-in. section was filled with a 16-lb Portland-type cement slurry containing one per cent bentonite and allowed to cure at atmospheric conditions for 18 days. The hardened cement had a compressive strength of 5000 psi and a tensile strength of 450 psi. Two such targets are used in comparative tests of the standard and the new shaped charge.

A 4-ft section of a standard 4-in. jet perforating gun was loaded with one standard jet charge and with one new shaped charge. Other openings in the gun were plugged. The test shooting setup is shown in Fig. 2. The gun was supported off the targets about ¾ in. by wooden blocks. Although this standoff distance may not compare with actual well perforating, it was used here for a direct comparison between the old and the new designed shaped charge.

After perforating, both targets were sawed in half and these are shown in Fig. 3. Note that the depth of penetration is comparable in both instances, but the more noticeable difference is the size of hole. The target on the left, shot with the new charge, contains a hole three times the volume of the conventionally-jet perforated hole at right. Size of the entrance hole is as much as four times as large.

**Controlling the jet.** Use of the flash X-ray in shaped charge studies has provided a mass of data from which newer developments will come in the future. This new charge is perhaps the first of a number of such improvements to be made in jet perforating. Research and field data are now available to permit the jet stream to be tailored to any specific job. Undoubtedly, other types of shaped charges incorporating this new idea will be perfected to meet a variety of specialized field applications. It is another step in getting a greater portion of explosive energy from shaped charges, or expressed in another way . . . getting higher efficiency from the energy released. ★ ★ ★

# Equipment, Supply Companies Consolidate to Form Continental-Emsco Company

CONTINENTAL Supply Company and Emsco Manufacturing Company divisions of The Youngstown Sheet and Tube Company are to be consolidated into one division known as Continental - Emsco Company, J. L. Mauthe, chairman of Youngstown, has announced.

F. M. Mayer

F. I. Brinegar

William T. Powell

Frederick M. Mayer, president of Continental, and recently elected a vice president of Youngstown, will be president of the new company.

Simultaneously, it was announced by Mayer that in the combined Continental-Emsco Company, William T. Powell will be executive vice president in charge of manufacturing and engineering, and Frank I. Brinegar will be executive vice president in charge of distribution. The following vice presidents of Emsco and Continental, W. C. Kinder, D. M. Bailey, and Raleigh Hortenstine, Jr., will continue as such in the new company. In addition, J. A. Mussler has been appointed a vice president, and will be in charge of all tubular sales (steel, aluminum, and plastic), as well as all pipe line equipment. Kinder will be in charge of machinery and allied sales.

Continental was organized in 1912 to serve the oil industry. During the first year, it opened and stocked 14 stores. Today it operates 70 stores in the United States, seven in Canada, and two in Venezuela. It has sales representatives in Mexico, throughout South America, Europe, and North Africa.

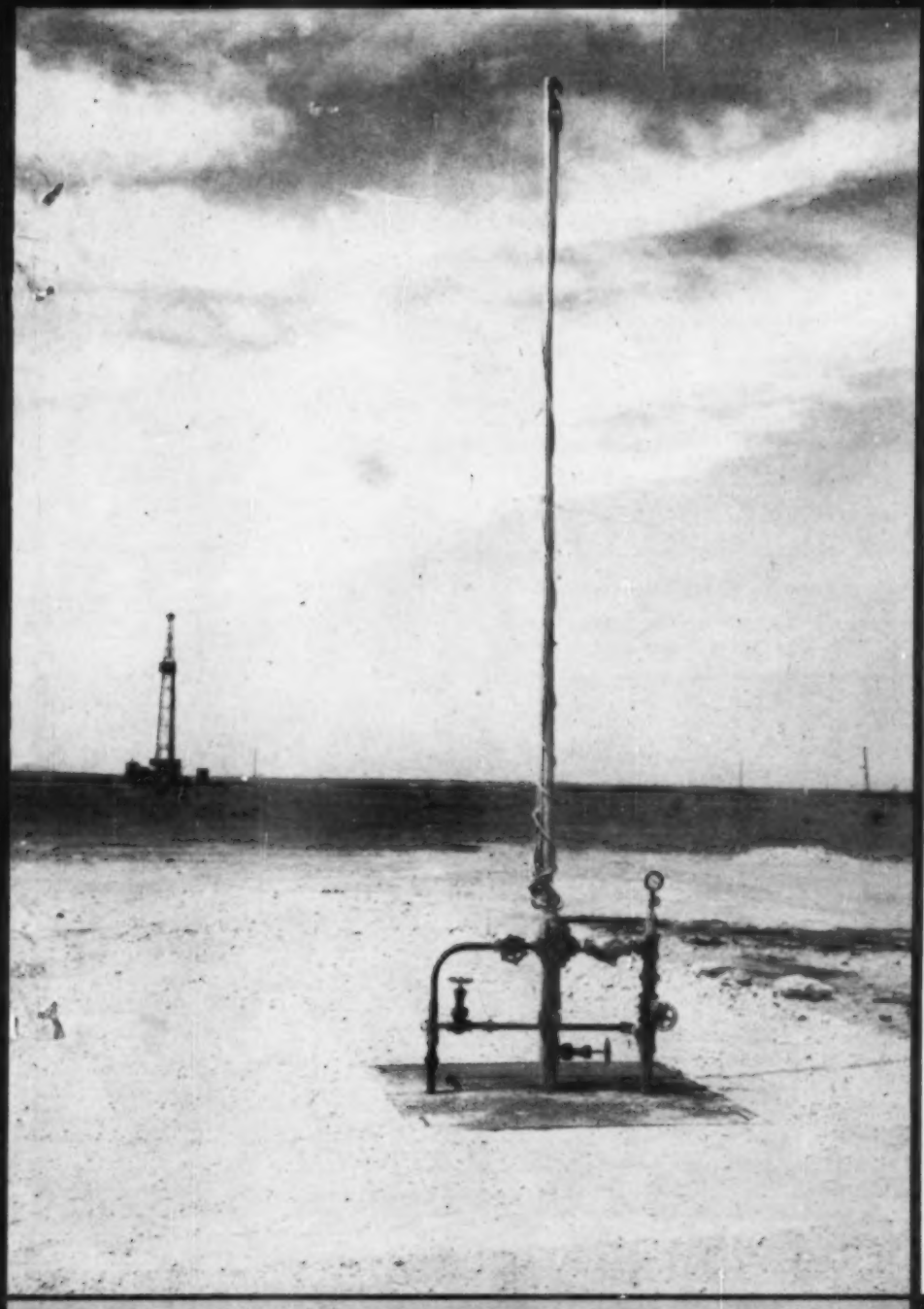
Emsco was organized in 1923, and a majority ownership of the company was acquired by Youngstown in 1938. Emsco manufacturers a wide range of oil well drilling and production equipment distributed by Continental Supply and others.

On October 31, 1956, Youngstown acquired the assets of Emsco preparatory to the consolidation with Continental Supply.

Frederick M. Mayer first joined Continental Supply as treasurer in 1932, becoming vice president in 1933 and president in 1945. In addition he is president and director of The Continental Supply Company, Ltd. (Canada), and of The Continental Supply Company Compania Anonima (Venezuela). He is a director of the American Petroleum Institute, Mid-Continent Oil and Gas Association, and the Petroleum Equipment Suppliers Association, as well as being a director of a number of corporations. He is a graduate of Heidelberg College, Tiffin, Ohio, and the Law School of Harvard University in 1924. Prior to coming with Continental Supply Company, he was engaged in the private practice of law.

Frank I. Brinegar entered the employ of Continental Supply in 1922, at Chanute, Kansas, as a field salesman. In 1925 he was made manager of the Wichita, Kansas, office, and promotions took him to the position of assistant district manager at Tulsa in 1928, then assistant to the president in 1929. In 1933 The Continental Supply Company removed its general offices from St. Louis, Missouri, to Dallas, and in 1935 Brinegar was elected vice president, becoming executive vice president in 1947. He was a member of the Petroleum Administration for War, "Transportation Division," during the construction of the Big Inch and Little Inch pipe lines, World War II, 1942-1943. Brineger is a director of The Continental Supply Company, Ltd. and the Texas Mid-Continent Oil & Gas Association.

William T. Powell joined Emsco in 1937 as chief engineer of the fabricating plate department. He became manager of war materials division in 1941, and was promoted to vice president of manufacturing, and in 1951 executive vice president; he became president of Emsco in 1952. Powell is also chairman and director of Emsco's British subsidiary, Emsco Engineering Company, Ltd. He is currently president and director of Metal Trades Association of Southern California and Pacific Coast District of the Petroleum Equipment Suppliers Association. Powell is a native of Wales, Great Britain, and a graduate of South Wales and Monmouthshire School of Mines in 1923.



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It is our specially constructed test well, completed in 1948. Since then, more than 6500 test surveys have been run . . . more than two-a-day every day of the year.

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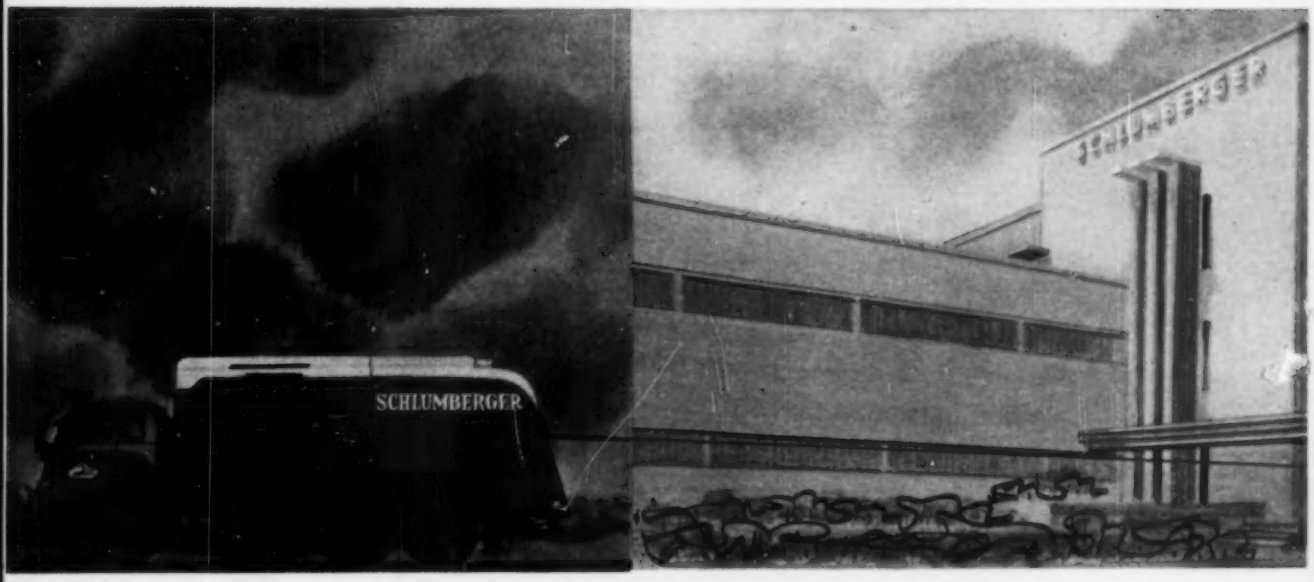


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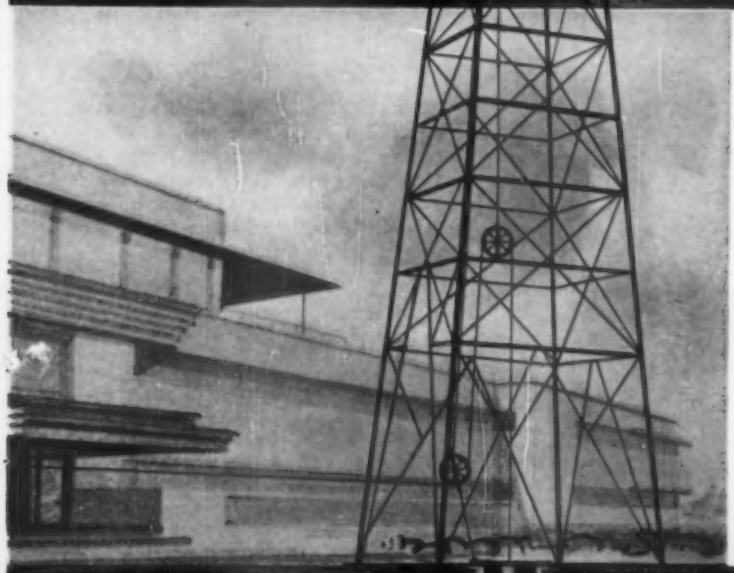

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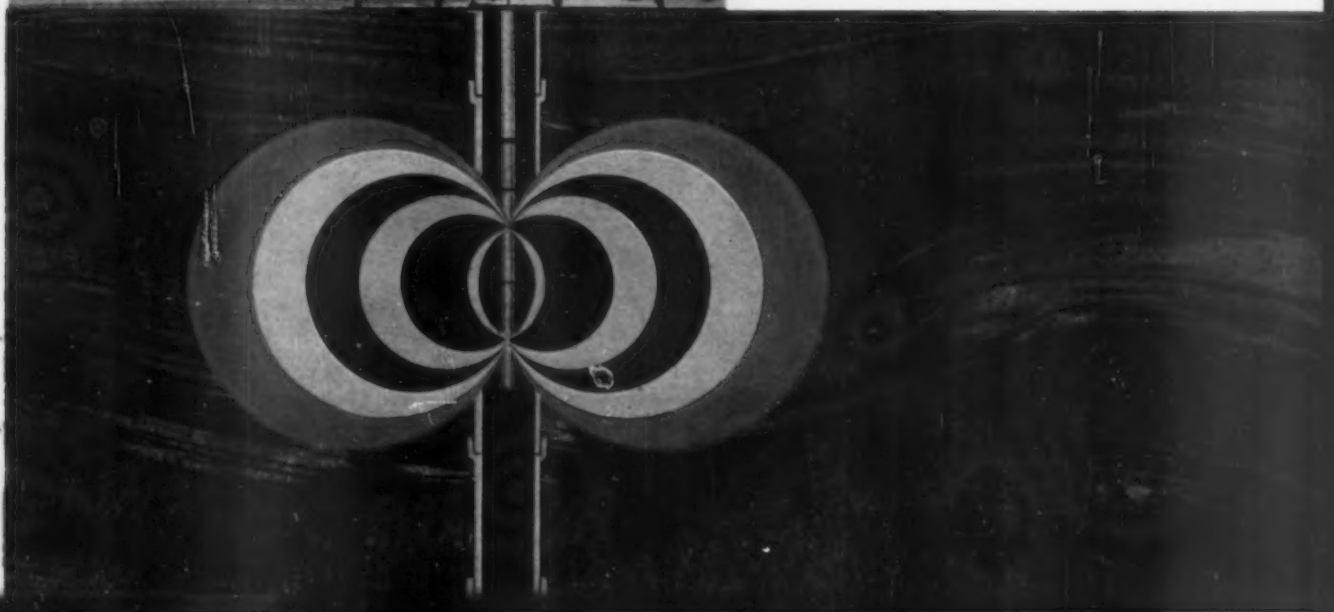
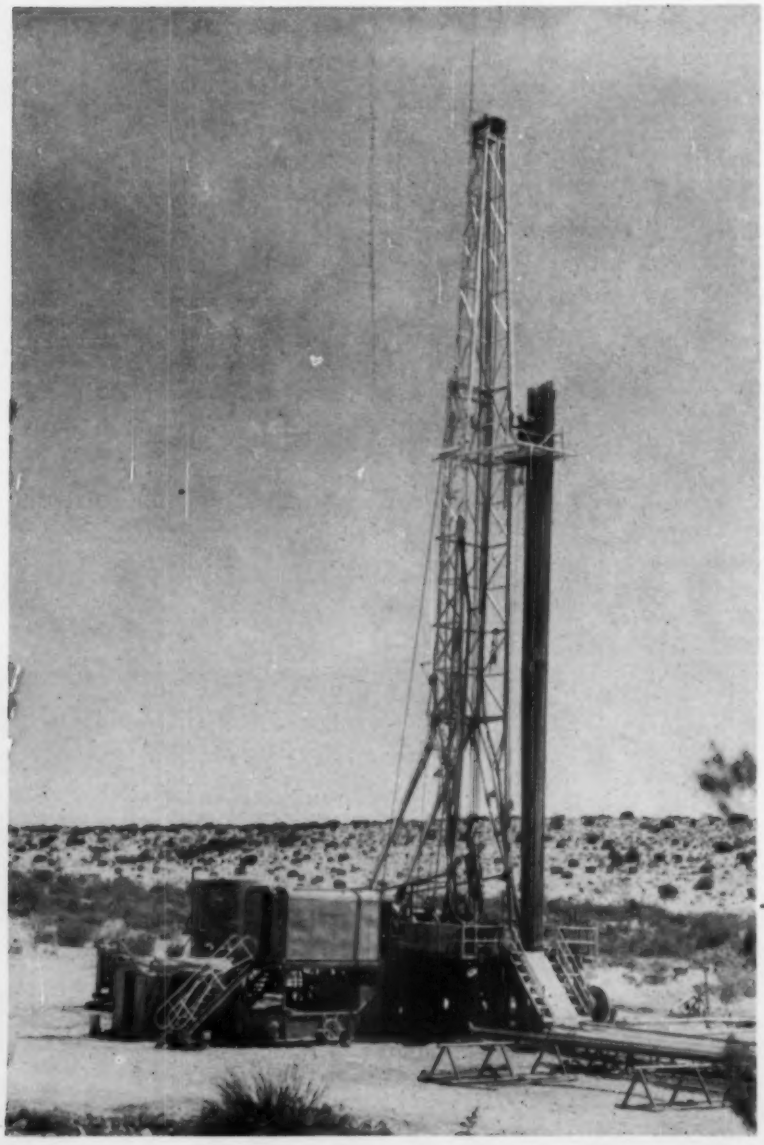


# IRION COUNTY-

# Graveyard Turned Goldmine

**Independents rush in as leases run out for majors in this West Texas area. Thirty operators make 17 new discoveries in the last two years — nearly all on big company farmouts**



**Mark A. Eidelbach and Orval Denman**
*Consulting Geologists, San Angelo, Texas*

SEVENTEEN new discoveries have been recorded during 1955-56 in Irion County to spark new activity in the southern part of the Texas portion of the Permian Basin. Prior to the last two years, only 16 fields had been found. Largely responsible for the surge of new discoveries are the large-scale lease block expirations.

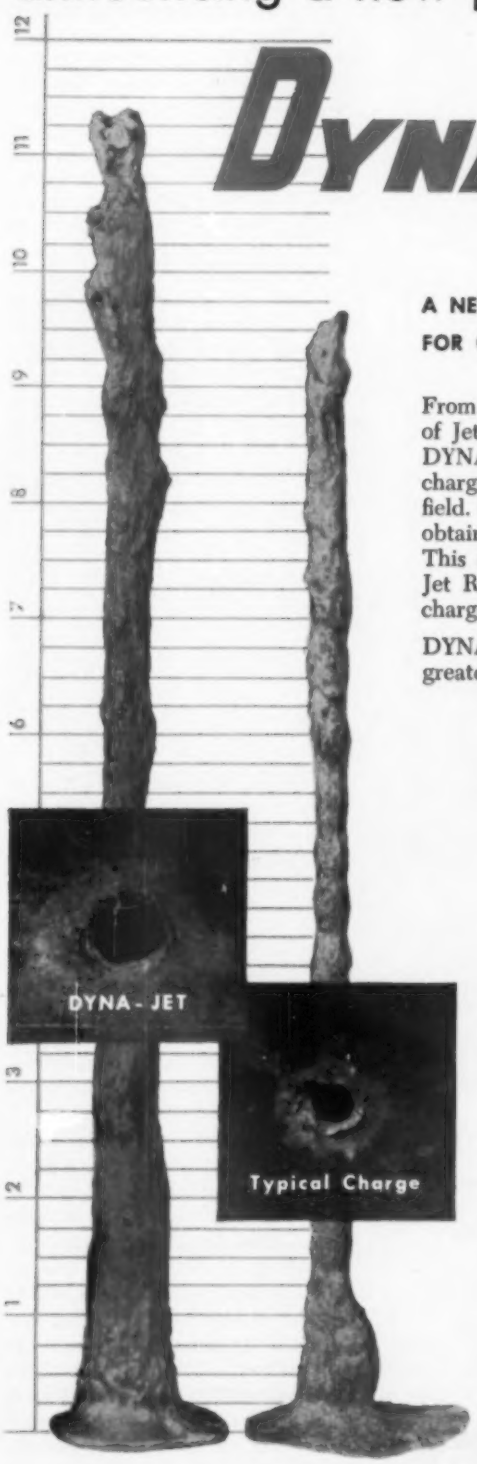
Irion County is just west of the Shelf area in the Permian Basin. One of the most attractive features that encourage the exploration is the large thickness of sedimentary rocks. This section varies from about 9000 ft thick on the east side of the county to about 12,000 ft thick on the west side. In this section, the Ellenburger, Strawn, Canyon, Wolfcamp, Spraberry, Clearfork, San Andres, and San Angelo formations have proved productive.

Shallow oil production in Irion County was established as early as 1928. First well to test the Ellenburger was drilled in 1929. This well was a

**Sixteen rigs,** similar to this one, were in operation in Irion County November 5-10 on wildcat locations. Of the 63 wel's drilled in 1956, 21 have been completed as discoveries or as major field extensions; 30 were dry holes and the remaining 12 were completed as field wells.

# announcing a new product of research . . .

# DYNA-JET*




**A NEW SHAPED CHARGE**
**FOR OIL WELL PERFORATING**

From the modern research laboratories and proving grounds of Jet Research Center, Inc., comes the announcement of the 4" DYNA-JET charge for use in hollow carriers, a new shaped charge that out-performs any present typical 4" charge now in the field. Larger entrance hole and greater penetration is obtained with DYNA-JET through a radically different design. This design is the result of cooperative effort between Jet Research Center, Inc., world-wide headquarters for shaped charge research, and Stanford Research Institute.

DYNA-JET is conclusive proof that industry can look to JRC for greater utilization of shaped charges through research.

## DYNA-JET PACKS MORE POWER

Tests prove that the DYNA-JET charge will out-perform any presently available charge of comparable size. In side-by-side tests fired under fluid with ½-inch clearance and shot into a composite target consisting of 14#/gal. neat cement with 1% Bentonite aged 16 days and faced with 5½"-17# N80 API casing, the following comparative results prove the superiority of the DYNA-JET:

| DYNA-JET | | Typical Charge |
|---|---|---|
| 0.58" | Entrance Hole Diameter | 0.40" |
| 11.28" | Total Depth Penetration | 9.66" |
| 38.4 cc | Hole Volume | 12.6 cc |

This means the DYNA-JET charge out-performs existing perforating charges by giving:

111 % more hole area
16.8 % more depth of penetration
205 % more hole volume

and assures more drainage area for maximum recovery. DYNA-JET gives a cleaner hole free of carrots. This new 4" charge is available through jet process licensees. Other sizes will be available soon.

Casts made of holes in test targets show the increased entrance hole and greater penetration obtained with the DYNA-JET.

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THROUGH RESEARCH

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cable tool test drilled to a depth of 8900 ft on the Edward J. Ashe, et al, ranch.

### Regional Geology

Irion County is in the southern part of the Permian Basin. This area received coarse sandstones from the encroaching Cambrian seas. The equivalent of the Hickory sandstone was deposited during this time. Later Cambrian deposits were coarse, glauconitic dolomites. The quiet, stable Ordovician seas deposited a thick section of limestones and dolomites in this part of the basin. The uplift and subsequent lack of deposition during the Silurian, Devonian, and Mississippian periods followed the close of the Ordovician.

The Pennsylvanian period began the formation of the present Permian Basin. This basin and the Delaware Basin were connected during most of the Pennsylvanian period with a deep channel at the southern end of the Central Basin Platform. Thin sections of limestone were being deposited in the basin, massive reefs were growing along the platform and basin area. Typical near-shore deposits of isolated sand lenses, shale and thin limestones were near the shore line and in shallow water to the east of this area during the Pennsylvanian period.

The early Permian seas spread over a large area of the continental United States from the Cordilleran Geosyncline, the Anadarko Basin, Delaware Basin, the Paradox Basin, and the Permian Basin. The late Permian epicontinental seas outlet to the open sea through Mexico was cut off by reefing along the Central Basin Platform. The Permian then became a regressive sea with increased salinity. The late Permian beds contain large quantities of gypsum, salt and anhydrite, representing the last sedimentary deposits of this sea.

The Triassic period is represented by a thin section of terrestial deposits of red shales and sandstones. The Jurassic period is not represented by a sedimentary deposit in this area.

Extensive, warm, shallow Cretaceous seas were conducive to the deposition of massive limestones that are exposed on the surface of Irion County and the Edwards Plateau.

### Irion County Geology

The Cambrian section has not yet proved productive in the county. This zone must be considered a potential, however, especially when structurally high.

The Ellenburger has proved productive in a few Irion wildcats, although these wells have not yet proved themselves commercially productive. The Ellenburger pools to the west of the county are excellent fields with good reserves. Lack of test wells that have penetrated the Ellenburger and the established production in adjoining counties from this formation indicated excellent productive possibilities.

Productive potential of Pennsylvanian sections was recently proved by the British American No. 1 Noelke, a Pennsylvanian reef discovery. This well was completed producing 206 bbl of oil per day from a depth of 6898-6908 ft. Other Pennsylvanian fields are the Dove Creek, Graywolf, Brooks and Lucky-Mag.

The Permian section has proved to be the most important section for production in the county. Permian rocks comprise one-half to two-thirds of the total sedimentary rock deposition in this area. The Permian-Pennsylvanian contact has not been clearly defined. The Wolfcamp is a series of limestones and dolomites with shale breaks and tight sandstones. The porous zones in this series are frequently productive. Recent discovery wells in this section

Throughout the oil world there are thousands of Roper Series F Pumps on the job. Big reason is *dependability*. Other reasons include: smooth, non-pulsating flow . . . equal size gears running in axial hydraulic balance . . . positive displacement requiring no priming . . . and importantly, four-port design. This latter feature of the Roper Series F Pump allows greater flexibility of installation . . . cuts installation time and costs. Four-port design, you see, permits 8 optional piping arrangements — 4 for CW and 4 for CCW operation. There are other Ropers in the line . . . in the pumping range and pressure range you require. Ask your distributor for all the facts . . . he'll show you how Roper can give you better service and higher efficiency in field storage, gathering line, and tank truck installations.

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**FITS ALL PIPE SIZES FROM 3½" to 13⅜"** by changing to the proper size latch lug jaw.

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**HANDY ADJUSTABLE STOP** limits the travel of the latch jaw... gives fast grip when tonging small pipe... trips to open jaw wide when large-diameter pipe is being handled.

**STRONGER HINGE CONSTRUCTION.** Greater strength is provided by large, oversize 1¾" threaded hinge pins double-slotted and doweled against rotation, adjustable to compensate for wear.

**BJ RED TOP TONG DIES WEAR LONGER**... take a better bite... have extra hardness and chip-proof ends... are tapered for fast changes of dies.

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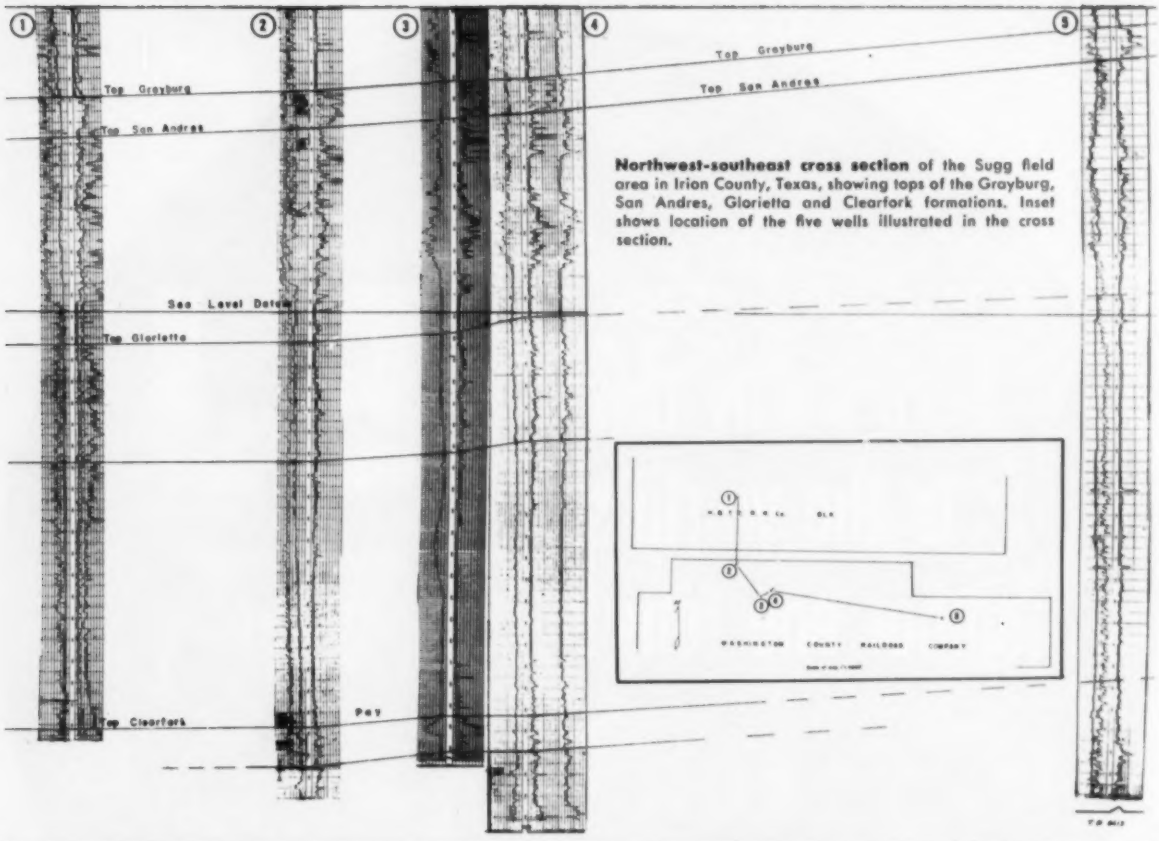
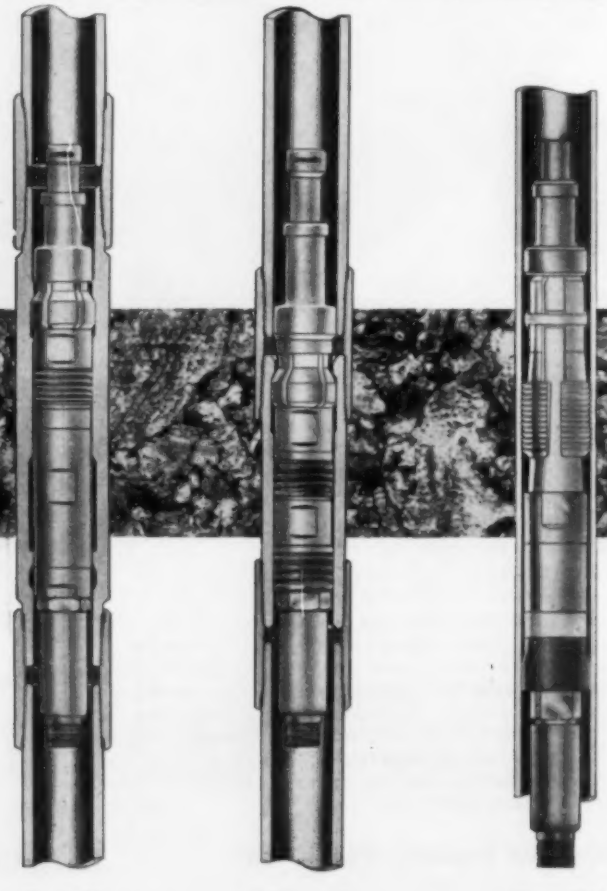



**Northwest-southeast cross section** of the Sugg field area in Irion County, Texas, showing tops of the Grayburg, San Andres, Glorietta and Clearfork formations. Inset shows location of the five wells illustrated in the cross section.




# Otis... "First in Pressure Control"



Type BS Type BJ Type BW

are the Woodward No. 1 Brooks, Plymouth No. 1 Sugg, and Tucker No. 1 Sugg.

The Spraberry, found in the Murphy No. 2 Ashe discovery well, is a fractured, tight, shabby, fine-grained sandstone about 30 ft thick. This section has to be treated to create sufficient permeability to produce. A new Spraberry discovery in the T. J. McIntyre No. 1 Sugg, potentialed for 118 bbl of oil per day. The Spraberry is present on the west side of the county from a depth of 4850 to 5000 ft.

The Clearfork sandstone discovery by Sinclair Oil and Gas Company brought forth shallow oil possibilities of the county. Since that discovery there have been five additional Clearfork discoveries. The Clearfork sandstone is of varying thickness (0-100 ft) and of varying permeability and porosity. Nature of this sandstone suggests a near-shore sand bar type of deposition. None of the Clearfork fields appear to be in a continuous sand section. The reservoir appears to be of the solution gas drive type. The Clearfork is topped at about 4600 to 4700 ft in the Sugg and Ketchum Mt. fields.

A productive section at 4350 ft was found in Ada Oil Company's No. 1 Ashe. This section correlates with a sandstone section in the Leonard series. The Ashe well is the only one producing from this zone.

Peterson field, the Stanolind No. 1-K Sugg and the Stanolind No. 1-B Sugg are the only recent discoveries in the San Andres. Discovery well in this section is the C. P. Simpson No. 1 Murphy. Shows have been recorded from this zone in a number of wells drilled in the area. Core analysis of the San Andres in the Murphy No. 4 Ashe indicates a solution gas drive type reservoir with a primary recovery of 210 bbl of oil per acre-foot. This section is from 500 to 700 ft thick with varying porosity and permeability.

The Grayburg is present in the western part of the county. This section has not proved productive at this time. This section has been cored and analyzed as oil productive, however, and should produce in sections of rocks where sufficient permeability and porosity are encountered. Core analysis indicates a primary recovery of 91 bbl per acre-foot from the Grayburg should it be of the solution gas drive type.

### Drilling Problems

Drilling conditions in this area are favorable. A few minor difficulties are encountered. Penetrating the Castille salt section is an example. Drilling this section necessitates the use of a salt base mud and the use of radioactive and limestone logs. Conventional electrical logs are almost useless in salty mud.

Irion County's Cretaceous surface presents some location and drilling problems. Pits must be blasted when the location is on top of the low hills. When drilling the surface hole in the Cretaceous, lost circulation problems are sometimes encountered. If sufficient water supply is available, this section is often "dry drilled" to the surface casing point. Below the base of the Cretaceous, lost circulation is not a common occurrence.

On the east side of the county, some extreme hole deviation problems have been reported. ★ ★ ★


For many years Otis Bottom Hole Chokes have been used as standard procedure to plug or choke the flow at any desired rate and depth in the tubing string. Otis Bottom Hole Chokes prevent freezing of surface controls by moving the point of pressure and temperature reduction to the lower portion of the well bore. The tool also maintains a constant bottom hole pressure, which tends to stabilize and hold the water-oil content consistent

OTIS BOTTOM HOLE CHOKES

and retard water encroachment. Many high-pressure production problems have been easily solved through the use of this and other Otis sub-surface controls.

If your plans call for the completion or workover of a high-pressure oil or gas well in the near future, ask an Otis representative to outline the many advantages of Otis Bottom Hole Chokes. A call to your nearest Otis office will bring you complete details and a competent recommendation as to the type of controls for your specific well conditions.

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BRANCHES THROUGHOUT THE OIL COUNTRY

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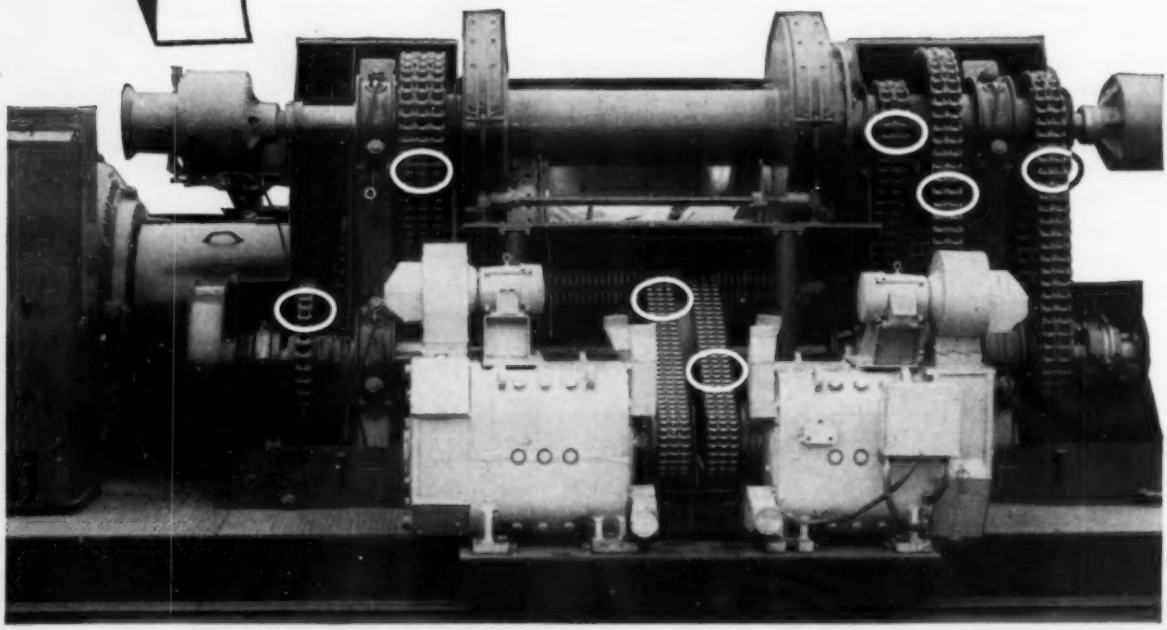
## *this new EMSCO drawworks delivers longer service life*



Every chain drive—seven in all—in this new Emsco EDES Drawworks is Rex Roller Chain.

Why Rex? Continental-Emsco Company knew from experience that *this* oil field chain would back up the extra speed and profits designed into this new drilling rig.

Greatly extended chain life does it. A revolutionary system of precision pitch control with fine degree tolerances assures *equal* load distribution over *all* parts. This way no one side plate is singled out for the load brunt ...no chance for costly early chain breakdown.

Here's another Rex reason: top-strength pin holes. A special manufacturing process imparts tremendous strength at these vital points.

What about disassembly? These rugged roller chains have "glide-fit" design...taking apart and recoupling are amazingly fast and simple. More money saved!

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**Paul D. Torrey**
*Petroleum Engineer, Austin, Texas*

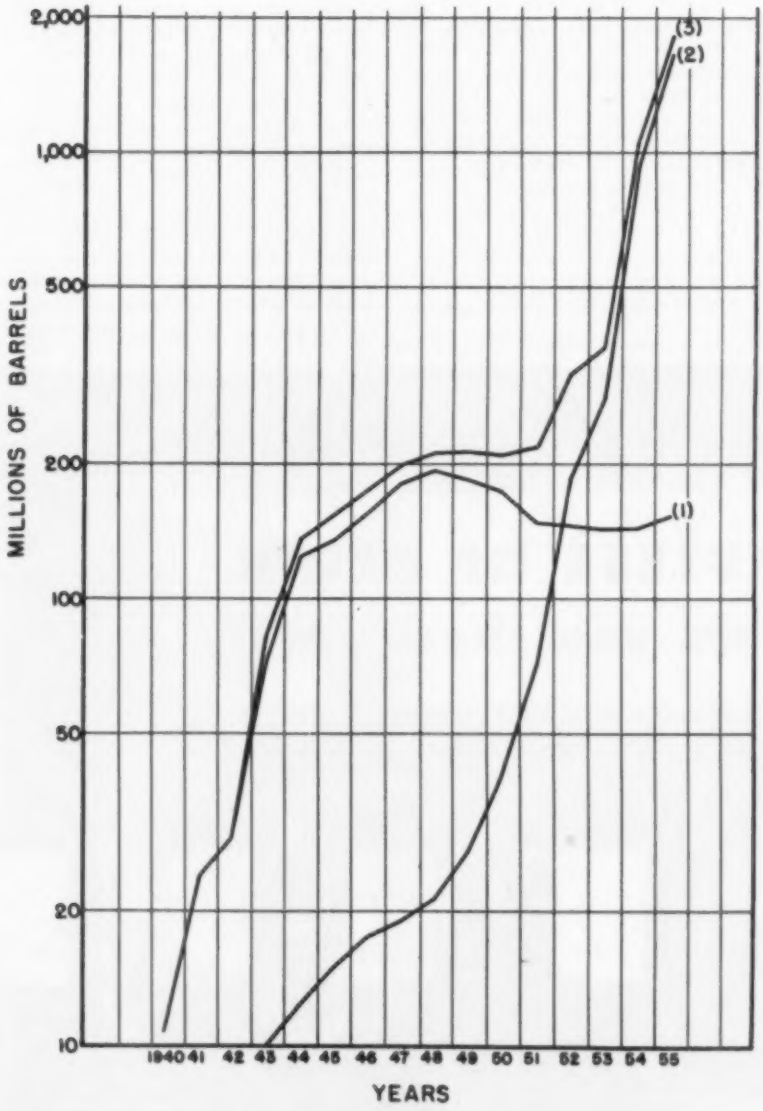


FIG. 1. **Fifteen years of water injection in Texas.** (1) East Texas field; (2) Estimation of all other projects; and (3) Total for the state. One-fourth of Texas' oil production is dependent in whole or in part on the use of water. Requirements to double in the next 10 years.

THE most important item in the utilization of water for the production of oil is the water supply itself. A certain source of supply is essential, and the physical and chemical characteristics of the water are of great importance.

Water is injected into oil reservoirs of many Texas fields to improve recovery where natural encroachment of water has not been effective. Frequently the recovery of oil is increased substantially by this process, and for that reason the application of artificial water drive has expanded tremendously in post World War II years. According to George H. Fancher,[1] director of Texas Petroleum Research Committee, the fields of Texas in 1955 produced oil at an average rate of 2,801,316 bbl per day. Of this amount, 852,631 bbl were produced from fields in which either water or gas, or combinations of the two fluids were being injected into the reservoirs. It is a reasonable estimate that some 680,000 bbl of this production came from fields where reservoir energy is being maintained or restored by artificial water drive. Thus, at the present time almost one-quarter of Texas' oil production is dependent in whole or in part on the use of water, and it can be predicted confidently that such use will increase in the future. It can be anticipated that within the next decade water requirements in oil production will double. Such increase is indicated clearly by the curves shown in Fig. 1.

Studies recently completed by the Texas Petroleum Research Committee[2] indicate some 10.5 billion bbl of oil in the state that is physically recoverable by artificial water drive; about half of this reserve will be recovered in fields where the effectiveness of the water injection process already has been demonstrated. This means a possible increase in oil recovery from known fields of the state of some 75 per cent.

Torrey is chairman of the Secondary Recovery and Pressure Maintenance Committee, Interstate Oil Compact Commission.

Oil that is being produced and can be produced in Texas by means of water injection has great value to the government of the state in support of its educational and eleemosynary institutions as well as to the industry. The value of the present daily production from this source is in the range of some $2,000,000 per day — of which the state will receive around $100,000 per day in the form of severance tax. At current prices the state's additional oil reserve has an undiscounted value of some $30 billion, and the state and its institutions can expect to receive $1½ billion from the production of this great reserve in the form of tax revenue. In addition to the direct benefits realized from increased income to the oil companies and from increased tax receipts, the people of Texas will secure many other benefits. These include increased royalty payments to land owners, continued profitable employment of many people, and greatly augmented purchases of supplies and equipment required for production of the additional oil. The prosperity that the use of water in oil production will bring to Texas is a compelling reason why any plan for the utilization of water in the state will be incomplete and inadequate if it does not include consideration of the water requirements of the oil industry.

The quantity of water that will be required for secondary recovery and pressure maintenance operations in the oil fields of Texas can be estimated in terms of almost astronomical proportions. It takes anywhere from 150 to 170 per cent of the total pore volume on an oil reservoir for an effective artificial water drive, which means that from 10 to 15 volumes of water will have to be injected into the reservoir for each volume of oil produced, the exact ratio being dependent on the porosity of the oil-bearing rock. From these proportions it can be estimated that a total of some 5.5 trillion gal of water will be required eventually for this important purpose.

### Refinery Water Needs

In addition to vast needs for water in the production of oil, large quantities of water are required in the oil industry for compressor plant cooling towers and for refineries. From 8 to 10 gal of water are required for each 1000 Btu of heat dissipation for the cooling of compressed gas, and around 420 gal of water are required for refining 1 bbl of crude oil. Seven barrels out of each 10 bbl of oil produced in Texas are refined in Texas, so it can be calculated that the refineries of the state need to have a little over 800,000,000 gal of water per day.

### Waterflooding Consumption High

The greatest requirement for water in most injection systems is during the initial stage of the operation, frequently referred to as the "fill-up" period, when that part of the reservoir pore system not occupied by oil and connate water is filled with injected water. During this period there is little or no return of water from producing wells that can be utilized. Since improvement in oil production does not commence until a state of fairly complete liquid saturation in the reservoir is approached, there is great incentive to complete the reservoir fill-up just as rapidly as possible, thus creating a heavy drain on the water supply during this period.

Experience in many water injection systems in older fields has shown that a unit injection rate through any input well of from 1 to 2 bbl of water per day per acre-foot of exposed oil reservoir rock during the fill-up period is desirable. Such injection rate will result in increased oil production within six to nine months after commencement without damage to maximum possible oil recovery. After fill-up has taken place the injection rate can be reduced about one half. The variation in specified injection rates has to be made on account of differences in the permeability of the oil-bearing forma-

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tions and on variations in their resistance to rupture by application of pressures in excess of the hydrostatic head. Higher injection rates can be maintained with safety in hard, rigid rocks possessing greater compressive strength than in soft, loosely consolidated rocks. With this knowledge the development pattern, well spacing, and injection pressures can be designed so as to conform best to injection requirements.

If depleted gas zones or water-bearing sections exist in the reservoir that cannot be isolated, much larger quantities of water generally will be required than will be necessary for the effective displacement of oil from the oil-saturated sections. Such conditions must be taken into consideration in estimating water requirements for any particular project.

In pressure maintenance operations in more recently discovered fields the water requirements usually are not as high as is the case in the older, more nearly depleted fields, this being due to the higher liquid saturation that exists in reservoirs during their early life. For pressure maintenance it is necessary that the reservoir be kept in volumetric balance by replacement of oil and gas by water in the pore system as these fluids are withdrawn. It usually takes about twice as much water as the volume of oil produced to maintain pressure because of shrinkage that takes place in the volume of crude oil as gas is lost from solution.

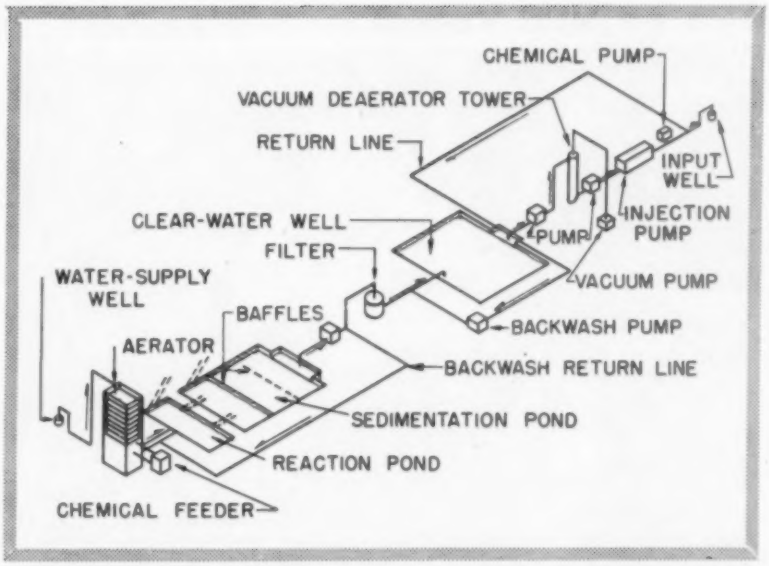
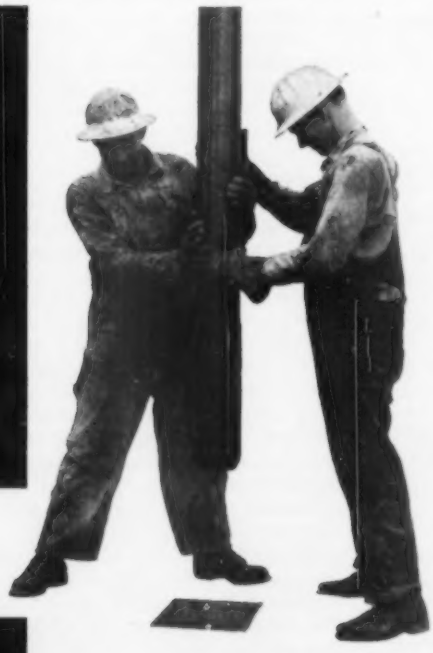



FIG. 2. **Water treatment** is big business. A simplified flow diagram of a semi-closed water conditioning system is shown here. Water must be cleared of suspended matter, as well as prepared so as to prevent the precipitation of insoluble compounds, control the growth of microorganisms, hydration of water-sensitive clays, and corrosion protection.

— Courtesy J. Wade Watkins, Bureau of Mines

Estimation of the complete water requirements for each project is quite important in order that it may be op-

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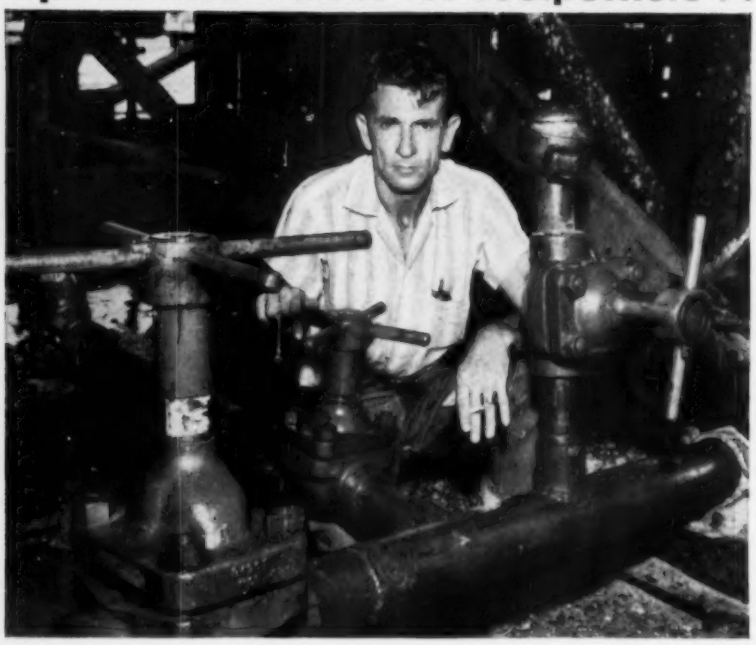
## Tips on Mud Valves for Toolpushers . .



**Bob Walker stops to look over a few of the MUDWONDER mud valves during rigging.**

# Veteran Oil Drillers Agree On MUDWONDER For Mud Valve Economy

**By Robert Walker, Toolpusher, Rig #2**
**J. & B. Drilling Company, Eunice, Louisiana**

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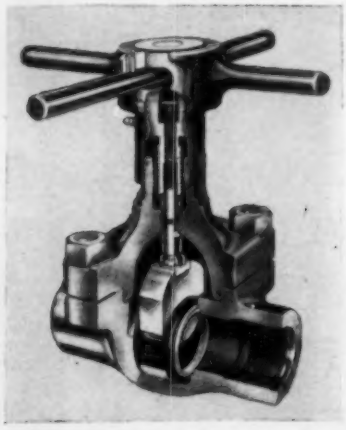
**MUDWONDER cut-away view shows the double thread construction, separated stainless stem and hard chromed gate with "T" slot connection and the one-piece seat insert with the buna-N molded integrally over the steel wear rings.**



Rockwell-Built MUDWONDER valves were put on all mudlines when the new "76" was rigged recently.

Past experience had proven the MUDWONDER valves as near trouble-free as a mud valve can be. So, it wasn't a difficult choice. Our vice-president, C. E. Bush, a veteran well digger, agreed that in sharply competitive contracting, J. & B. could not afford inferior valves.

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MUDWONDER valves are built in 2", 3", and 4" sizes with screwed or flanged ends for 2000 psi WP (4000 psi test) and 3000 psi WP (6000 psi test).

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erated in the most efficient manner. Also, if the total water requirements can be established with reasonable accuracy it is then possible to predict the life of the project by dividing the total requirements by the daily or monthly injection rate.

### Sources of Water Supply

Once the water requirements of a secondary recovery or pressure maintenance project have been established, consideration must then be given to possible sources of supply. Water sources may be either fresh or saline, and they may have surface or subsurface origin. Where salt water is available at low cost, it is preferable in many cases to fresh water, a very important item in arid regions.

Nature rarely provides chemically pure or bacteria free water in any substantial quantity. Water, whatever its source, ordinarily contains a variety of impurities that may be inorganic, organic, or both. Even though these impurities may be present in very minute quantities, their existence must be recognized in almost every water injection system. Taste, color, or toxicity of the water, important items where water is to be used for human consumption, however, are relatively unimportant in oil field use. The principal problems connected with the use of water to improve oil recovery are the presence of suspended matter that can plug the pore system of the reservoir, possible reaction by the water with the reservoir and its contents, and whether the water will cause destruction of surface and subsurface equipment by corrosion.

In the early days of secondary waterflooding operations in Pennsylvania little attention was given to the preparation of water, for an ample supply of fresh water of good quality was available from shallow aquifers. In the Southwest and particularly in Texas no such fortunitous conditions exist. Just as cities have been forced to import water from far places for the maintenance of their population and industries, it is certain that the oil industry of the Southwest must begin to seek sources of unpreempted water, to investigate the most economical way in which such water can be transported from the point of origin to the point of use, and to devise methods of treatment that will make water suitable for injection into particular oil reservoirs. In almost every case such waters will require some form of treatment before they can be used with safety. For that reason the importance of proper conditioning of water to be used for such purpose is now rather generally accepted.


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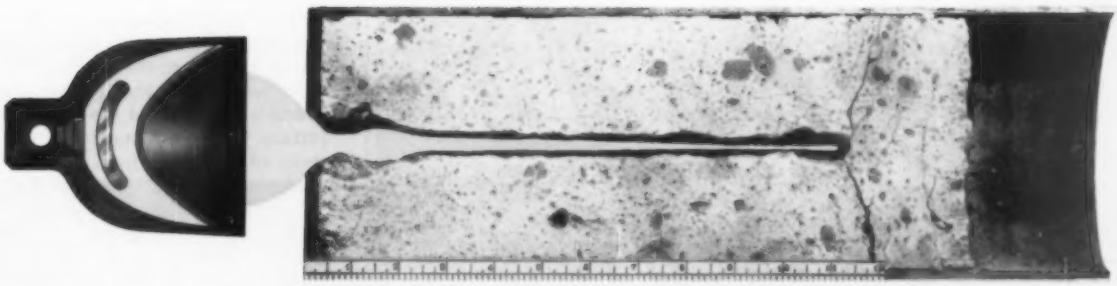

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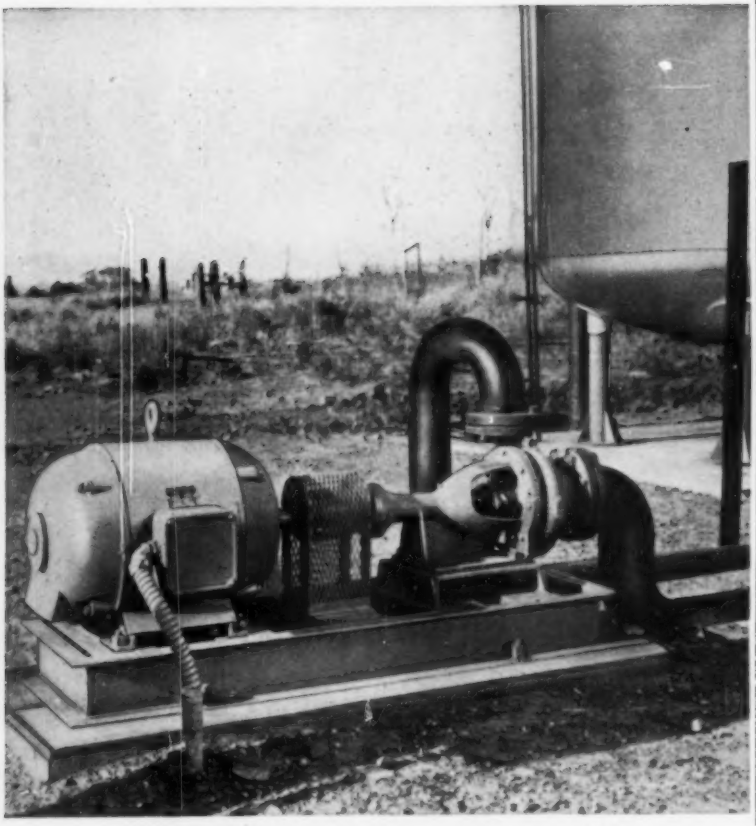

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Use of produced water or water from a nearby oil field usually proves to be a partial solution to the problem. Many times necessity for the disposal of produced water to avoid the pollution of surface waters will justify its use instead of a supply from some other source even though the cost of treating produced water may be more expensive.

R. C. Earlougher and Ray W. Amstutz[3] recently described in considerable detail problems connected with the procurement of water supplies for secondary recovery and pressure maintenance operations. Their classification of water sources is used in this paper.

Fresh water can be obtained from surface sources, from alluvial deposits, and from subsurface aquifers. Salt water sources include subsurface aquifers and the oceans.

### Fresh Water Sources

Surface sources of fresh water include ponds, lakes, and streams. In the Eastern states surface sources have been used extensively for waterflooding, notwithstanding the fact that there is keen competition for this supply by other industries and by municipalities. Generally, small ponds and streams are unreliable sources during all seasons, and even larger bodies of fresh water and rivers may have limitations where water from them is used for domestic purposes. Domestic use, including fire protection, will usually have priority over use for the production of oil. In addition, seasonal turbidity of surface streams requires elaborate filtration to prepare the water for subsurface injection, thereby making it less desirable.

Fresh water occurring in shallow alluvial deposits along river channels is a more reliable source of supply, although if the river should cease to flow during periods of drought, the reserve of water can be exhausted unless replenished by a renewal of flow. Water from alluvial deposits has been used extensively in some of the largest secondary projects. Its quality is usually good, and since the alluvium acts as a filter there is no problem from turbidity. If the alluvial deposit is extensive, water can be produced in large quantity and at low cost.

Fresh water can be produced in large volumes from many underground aquifers, such as the Eocene sand series of East Texas and South Texas, and sometimes from considerable depths. Water from such sources is usually of good quality and requires little preparation to make it suitable for injection purposes; however, both development and production costs of deeper subsurface sources are much higher than

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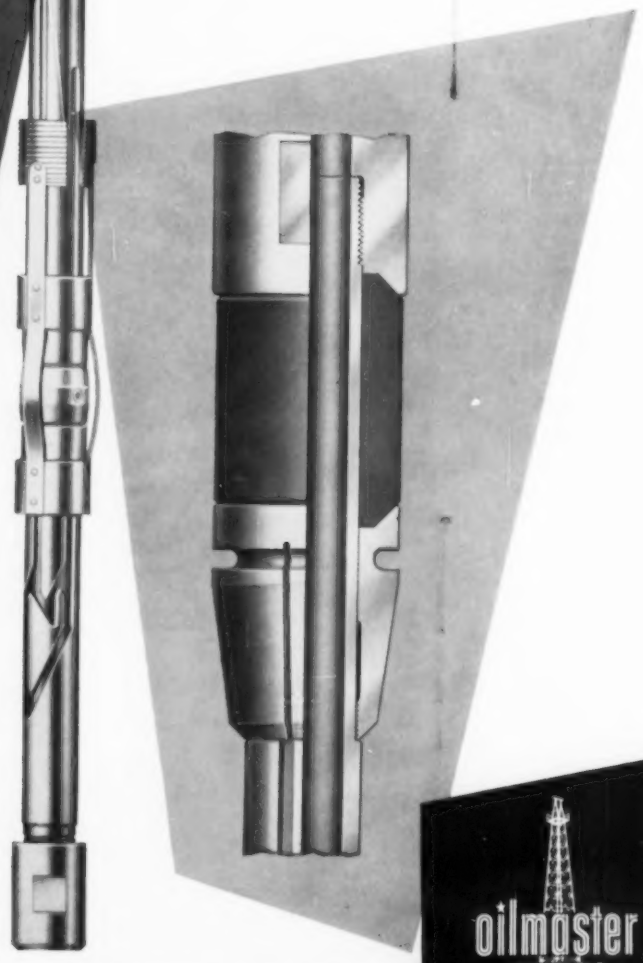

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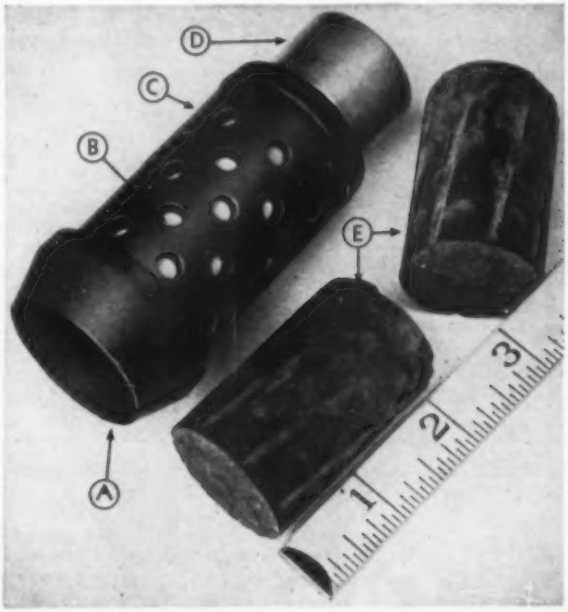


(Right) PGAC's 32-shot Jumbo sidewall coring tool.
(Above) PGAC sidewall coring projectile and cores: A — Cutter; B — Mud extrusion ports; C — Core barrels; D — Powder chamber and retrieving cable housing; E — Large PGAC Jumbo Cores.

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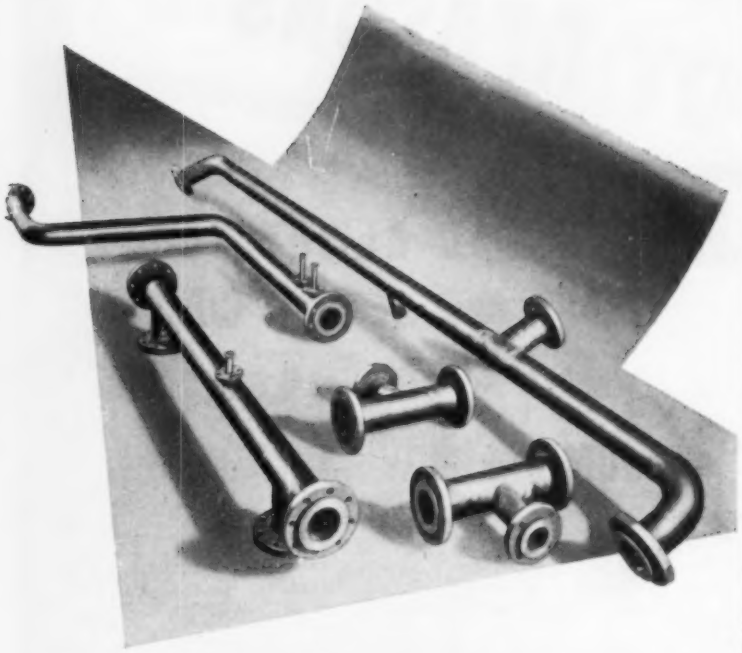

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other fresh water supplies for artesian flow rarely can be maintained for prolonged periods. Also, this source must be regarded in many places as a reserve for municipal use.

### Use of Salt Water

In many oil fields there are salt water-bearing formations in close proximity to the producing formation. Such sources, undoubtedly, constitute the most important future source of water supply for oil production purposes. Frequently, edge wells that fail to produce oil or have become depleted can be converted at low cost for the production of water. The cost of producing salt water is usually more than for fresh water, and it generally requires more extensive preparation to make it suitable for injection into oil reservoirs.

Use of water from open or landlocked seas is, in principal, applicable whenever the site of an oil field is sufficiently near to the source of marine supply that transportation costs will not be excessive. Utilization of sea water has not received the consideration it deserves. In arid South Texas, for instance, where in many fields only limited quantities of fresh and salt water have been found, the nearby Gulf of Mexico would seem to be a ready solution to the problem of water supply. Ocean water has the advantage of an inexhaustible supply, and low development and production cost. Similar to most subsurface salt water supplies, water from the sea will have to be treated for oil production use.

As mentioned previously, produced salt water is extensively reused in many secondary recovery and pressure maintenance projects. Produced water in the aggregate will comprise anywhere from 30 to 60 per cent of the total water requirements of a project. Thus, if the cost of producing water from other sources is high a considerable saving can be obtained by reuse of produced water, even though produced water almost invariably requires some form of treatment before it can be used successfully for injection purposes.

### Water Treatment

The treatment required to make water suitable for injection into oil reservoirs varies in accordance with the characteristics of the water and sometimes is quite complicated. Removal of suspended matter, prevention of precipitation of insoluble compounds, control of the growth of micro-organisms, protection of equipment from corrosion, acceleration of water injection rates, and control of hydration of water-sensitive clays are problems that

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require consideration in many oil fields. A simplified flow diagram of a semi-closed water conditioning system is shown in Fig. 2.

If turbid water is allowed to remain stagnate for a considerable period of time most of the suspended matter will settle out and will accumulate at the bottom of the storage reservoir. Since this is a slow process and requires large storage capacity, the removal of suspended matter many times is accelerated by the use of a coagulating chemical such as alum.

Precipitation of insoluble materials may be due to physical causes, such as changes in temperature, or to chemical reactions. In either case the formation of insoluble compounds results, the most frequent being carbonates, sulfates, sulfides, and hydroxides. These materials may form in water distribution systems or on the face of the reservoir rock as it is exposed in water input wells. Formation of insoluble materials many times can be controlled by use of a closed water distribution system, i. e., one in which water does not come in contact with the atmosphere, and which will tend to hold carbon dioxide in solution. Precipitation of other insoluble materials, such as salts of calcium and iron, may be prevented by the use of complex phosphates or organic sequestering and chelating agents. Organic compounds control undesirable precipitation or divalent and trivalent basic compounds by deionization.

### Bacteria Treating Problems

In many water injection systems the control of growth of micro-organisms and the closely related problem of prevention of corrosion resulting from the life metabolism of sulfate-reducing bacteria or from treatment employed to destroy them, is a problem of considerable magnitude. One-celled plants and animals are prevalent in almost every oil field water, but they are particularly troublesome in warm and tropical climates where the temperature environment is most favorable for their multiplication. Their growth is retarded by cold weather. The anaerobic types will flourish underground and may remain undetected until wells become plugged by collection of bacterial masses.

Growth of algae is rather easy to control; control of sulfate reducing bacteria has proved to be much more difficult. These organisms are widely and abundantly distributed in nature, and they are the only forms that have the ability to reduce the sulfate ion to hydrogen sulfide, the presence of which in any water will cause the corrosion of iron and steel equipment. Since they require no oxygen for growth and multiplication and are tolerant to great differences in environment, they are found in varying numbers in most subsurface waters, both fresh and salt. Notably enough, they cannot be destroyed by aeration. They are quite resistant to many bactericides, and once a water injection system becomes severely infected with them, an expensive treatment may have to be employed to clean up the system and thereafter to enable the establishment of effective bacteriostatic control.

Chlorine has been widely used to prevent the multiplication of anaerobic bacteria in water injection systems. However, similar to the life cycle of many other one-celled organisms, the sulfate-reducing bacteria, in course of time, frequently will develop so rapidly that the normal residual concentration of chlorine will not retard their growth. When a virile strain of bacteria appears in water and their multiplication cannot be controlled by chlorine, the best known means of reducing infection is by means of organic bactericides.

Some of the most effective organic bactericides are combinations of cationic quaternary ammonium salts with or without formaldehyde. These substances, also, are good corrosion inhibi-


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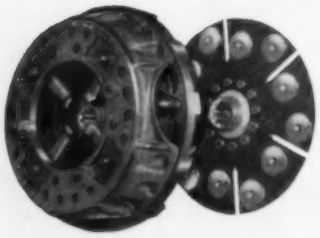

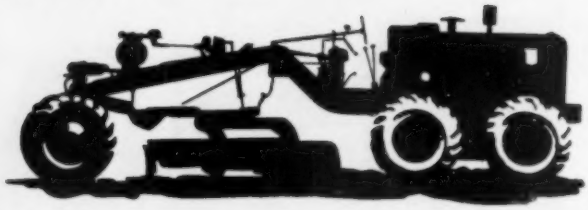

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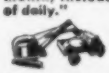

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tors and, therefore, one chemical treatment will accomplish two purposes. It is believed that the film-forming properties of the cationic organic bactericides are responsible for the formation of a chemical coating around the cell of a bacterium that prevents its normal metabolism, thereby preventing multiplication. Thus, the bacteria are not poisoned, as is the case when toxic bactericides are used. Rather, they are starved.

In the East Texas oil field, where bacteria are a serious problem in the water disposal system, it is not considered necessary to obtain complete sterilization of the water. Such treatment would be so expensive that the cost would be greater than the benefits derived from total elimination of micro-organisms. Thus, a treatment sufficient to create a static condition in bacterial growth is considered to be adequate.

### Corrosion Control

Control of corrosion of metals is one of the most serious problems connected with the injection of water into oil reservoirs, particularly in cases where the water has a high saline content. In general, it will be found that high water salinity corresponds closely to a high corrosion rate. In addition to the salinity of the water, however, corrosion can result from dissolved gases in the water, such as oxygen, carbon dioxide, and hydrogen sulfide — from the contact of different metals one with the other, and by high liquid velocities in the water distribution system.

Various methods are used for the control of corrosion, such as exclusion of corrosive gases, use of corrosion resistant materials, use of nonmetallic substitutes for steel, the use of protective coatings, and the use of chemical inhibitors. Among the various chemical inhibitors that are available, the cationic organic compounds, which have proved to be such effective bactericides, are widely and successfully used. The ability of these materials to inhibit corrosion is believed to be due to their adsorption on metal surfaces to form a protective film. They are effective in low concentration, and certain of them are completely compatible with oilfield waters so that their use will not cause formation plugging. The organic inhibitors generally are not toxic to animals in the concentrations usually recommended. Therefore, danger from livestock poisoning, a serious and ever present problem in ranch country, is eliminated.

Nonionic surface active agents, which will reduce interfacial tension between water and the surface of the reservoir rock, have been employed with great success to accelerate the rate of water input into shallow or tight reservoir rocks where it is not practical to employ high injection pressures. It has proved to be possible to use these materials at very low concentrations to reduce the time required for the depletion of waterflooding projects, and at the same time to secure the maximum economic recovery of oil with a lower produced water-oil ratio, saving a considerable amount of water.

### Clay Plugging

The efficiency of many water injection systems has been reduced severely and several outright failures have resulted from plugging of the reservoir rocks by swelling of clay minerals when water is brought in contact with them. This alteration may occur as a result of water adsorption phenomena or as a result of exchange of basic radicals when foreign water is introduced into the formation. By either process, the volume of the contained clay can be increased substantially with resulting loss of formation permeability. The clays present in the oil-bearing formation, therefore, can have a profound influence on the flow of fluids and on the displacement of oil by water.

Clay swelling can be controlled by the use of highly acidic brines which, however, create corrosion problems. A

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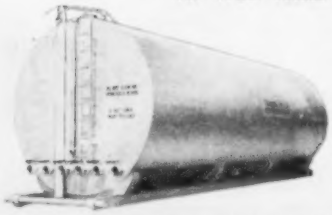

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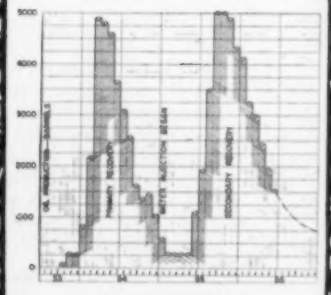

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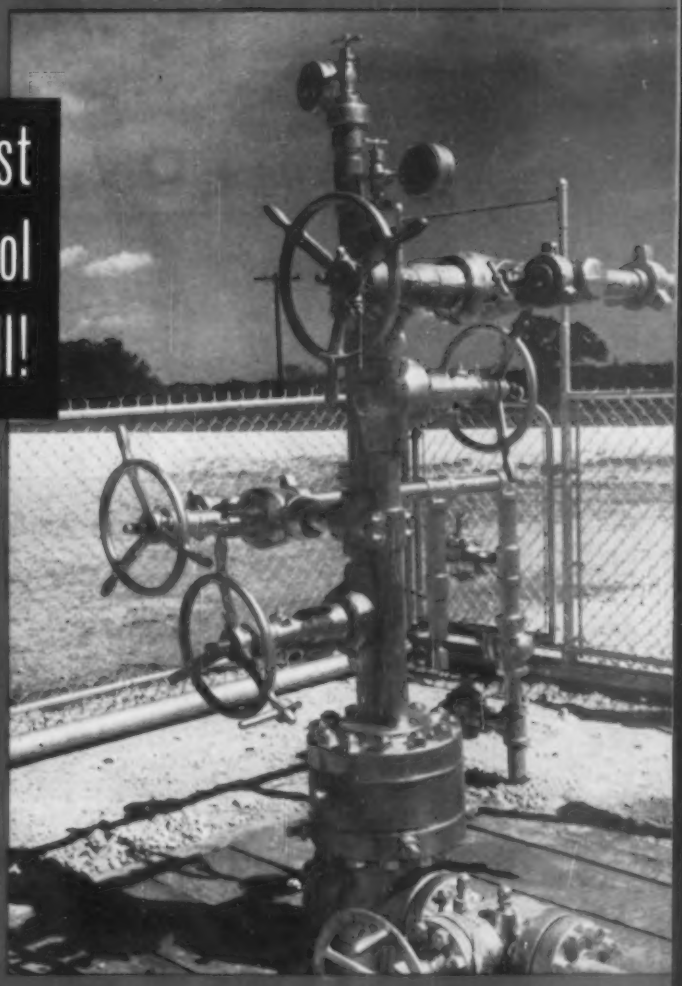

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less troublesome and sometimes much more effective method, developed by J. H. Prusick, was described recently by the writer.[4] It consists of a pretreatment of the formation surrounding a new water input well with sufficient hydrochloric acid to cause a radial penetration of from 4 to 5 ft from the wellbore. The acid is allowed to remain in the pores of the rock for several hours so that it may come in intimate contact with all clay minerals susceptible to swelling and thereby contract them to minimum size by hydrogen ion replacement. Immediately after the spent acid is retrieved the injection of water containing very small quantities of cationic and nonionic surface-active chemicals is commenced. As shown by many laboratory tests, cationic compounds are absorbed preferentially on the surfaces of the flocculated clay particles which serves to make them water repellent, or in simple terms, they are "water-proofed". In this condition they are not affected by water, and if the chemical treatment is continued, a high degree of permeability to water can be maintained.

### Oilmen Share Water Shortage

Many oil fields in Texas that have possibilities for greatly improved recovery are located where shortages of surface and subsurface water supplies already exist. As the demand for water increases, the shortage will become more acute. The importance of greatly increased oil recovery to the economy of the state, its institutions, and its people has been emphasized. Also, an attempt has been made to show how water can be used for the production of oil in a manner which will minimize waste and which will conserve fresh water for irrigation and for domestic purposes. The great importance of this additional oil recovery, however, should provide a positive reason why consideration of the great need for water in the production of oil should be included in the formulation of all plans for the most effective utilization of the water resources of Texas.

### Acknowledgment

This paper was presented at the "Water for Texas" conference at Texas A and M College, College Station, Texas, September 19, 1956.

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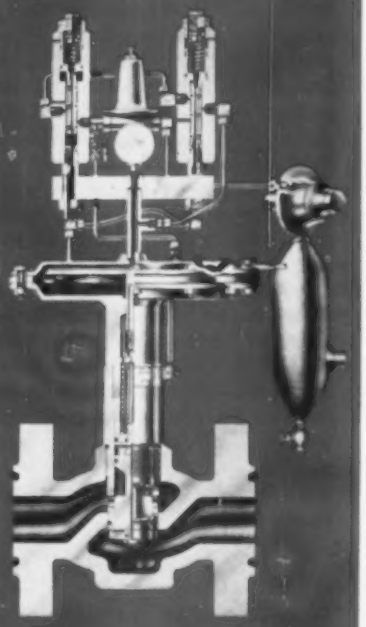
(4) Torrey, Paul D., "Preparation of Water for Injection into Oil Reservoirs", AIME, Secondary Recovery Symposium, Wichita Falls, Texas, November 17-18, 1954. ★

got

# WELL HEAD SAFETY VALVES

A-1



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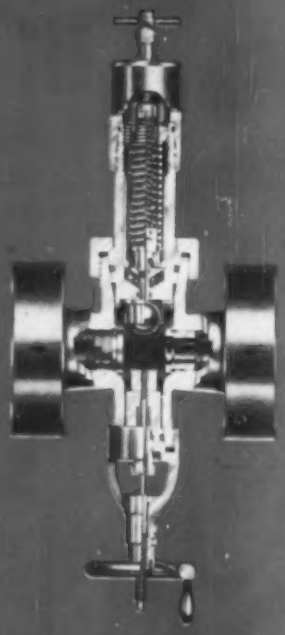

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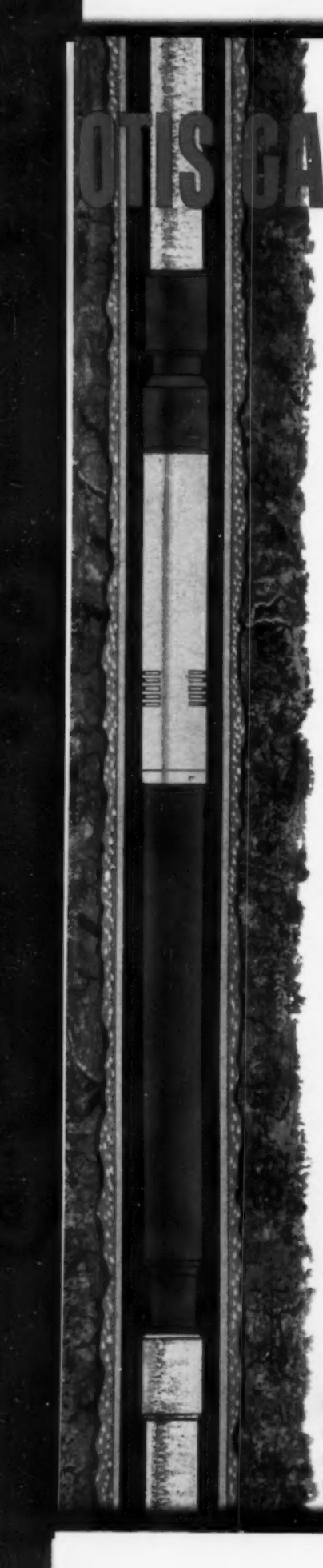


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## 8 Phillips Officials Die In Oklahoma Plane Crash

Eight officials of Phillips Petroleum Company were killed December 12 in a company plane which exploded and burned in a snow-covered ranch pasture shortly after its takeoff from Bartlesville, Oklahoma.

Listed as dead were: A. M. Rippel, 61, manager of Phillips' natural gas department, a graduate of Bucknell University who joined Phillips in 1925; C. A. Binkley, 45, chief gas-production engineer who had been a Phillips' employee for 20 years; D. F. Mayfield, 49, staff director of gas valuation and procedures; T. D. Young, 31, an Oklahoma A&M College graduate who joined Phillips in 1951 and was supervisor of gas records and procedures; W. C. Reed, 37, staff director of gas contracts; George L. Sneed, 43, company land attorney who joined the Phillips legal staff in 1939; Joe Bowers, 38, pilot, and R. E. Ullrich, 36, copilot.

The crash, which was the first involving a company plane since Phillips began using aircraft more than 15 years ago to transport personnel, occurred in a pasture on the Redbird Ranch of Dick Kane about four miles south of Bartlesville. The group was on a flight to Salt Lake City, Utah. According to witnesses, shortly after takeoff from Bartlesville, the craft developed engine trouble. Bowers, the pilot, was trying to turn back to the Bartlesville airport when the plane spun an estimated 1200 ft into the field.

## Atlantic Drilling Two New Wells in Venezuela

The Atlantic Refining Company has started drilling a wildcat well in the Pedernales area of Venezuela. A depth of 2700 ft has been reached and drilling is projected to about 10,000 ft.

The company will drill two wells in this area by which they will earn a half interest in a block of approximately 30,000 acres. Creole Petroleum Corporation has had production of heavy oil from shallow depths in this same area for several years.

Atlantic has also begun the drilling of an offset to the recently completed Sinclair Oil Corporation Aguasay No. 3 well located in the state of Monagas, Venezuela. A depth of 6300 ft has already been reached and, if projected to the same horizon as the Sinclair field, drilling will go to about 13,500 ft. Atlantic holds approximately 13,500 acres in this area jointly with Pancoastal Petroleum Company.

## THROUGHOUT THE OIL WORLD

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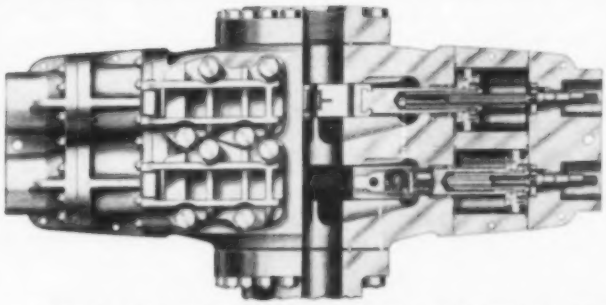

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• Available in both *Double* (illustrated above) and *Single* types. Both available in choice of *Non-Rising* Locking Shafts (for those preferring maximum compactness) and *Rising* Locking Shafts (for those preferring quick indication of ram position).

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• Completely Enclosed Design . . . Direct Hydraulic Drive . . . Quick-Draining Compartment Bottoms . . . these and other exclusive features make Shaffer Hydraulic Cellar Control Gates outstanding in the industry.

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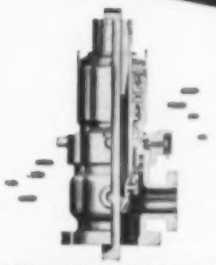

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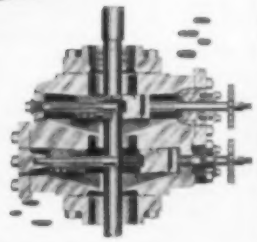

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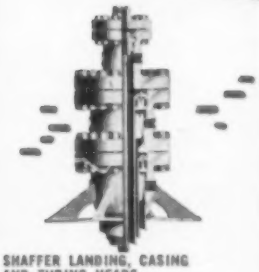

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# Sun Oil Organizes Foreign Department, Five New Companies

Sun Oil Company has established a foreign operations department and organized several subsidiary companies to engage in oil exploration and production activities in Latin America, the Bahamas, and Pakistan.

Ted C. Stauffer, Philadelphia, formerly manager of Sun's central production division, Evansville, Indiana, and more recently administrative assistant to the vice president in charge of production, has been appointed director of foreign production operations, a new post.

The principal division thus far established of the new department is a Latin America division, of which B. E. Warren, Dallas, Texas, has been appointed manager. Warren formerly headed the natural gas department of the company's southwestern production division at Dallas. He was associated with Sun in Venezuela from 1920 to 1925.

Assisting Stauffer in the management of the new department are Winfield Givens, who serves as foreign representative for the department in addition to managing Sun's land department in Philadelphia; Herbert J. Weeks, Philadelphia, whose appointment as geological counselor for foreign operations was announced recently; and J. W. Timmins, Dallas, formerly general attorney of the company's southwestern production division, and now special counsel for foreign operations.

Warren's Latin America division is organized into three main departments — geology and geophysics, headed by Paul W. McFarland, Dallas; operations, headed by Kenneth E. Montague, Maracaibo; and accounting and purchasing, headed by Davis B. Crow, also Maracaibo.

McFarland, who served as a geologist for Sun in Venezuela in the early 1920's, has most recently been assistant chief geologist for the southwestern production division. Montague formerly was supervisor of the reservoir study section of the company's Gulf Coast production division, headquartered at Beaumont, and Crow was section supervisor in the gas accounting department of the southwestern production division.

Earl B. Wilson, Jr., has been appointed assistant to the division manager for Latin America. He formerly was an oil scout and landman in Sun's central production division.

Stauffer is president of three of the subsidiary companies — Venezuelan Sun Oil Company, Colombian Sun Oil Company, and Pakistan Sun Oil Company. Warren is vice president and general manager of the first two of these companies. Other subsidiary companies involved in Sun's expanding foreign activities are Sun Production Company of Bahamas and Sun Production Company (Delaware), operating in Guatemala. Sun operates in Cuba and Canada under the name of the parent company.

Sun recently has been successful, in association with other companies, in bidding for oil concessions in Venezuela and Guatemala. It has held a concession in Cuba for some years and recently acquired a large concession in the Bahamas. Currently the company is negotiating for exploration interests in Colombia and Pakistan. ★ ★ ★


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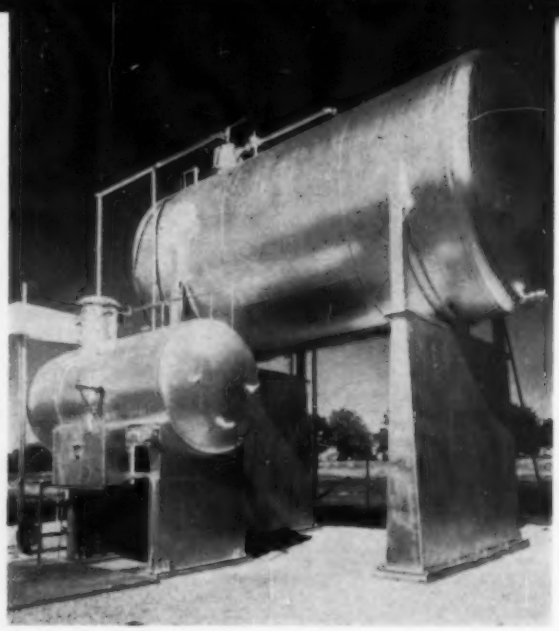


**Stanolind's LACT unit** is one of the newest devices recently developed by the industry. Chief parts of the system, aside from instrumentation, are the 400-bbl elevated storage tank and the 60-bbl metering tank.

# Pneumatic LACT System Trims Labor, Maintenance Costs

## Stanolind designs unique, simple lease automatic custody transfer (LACT) unit to gage, grade and run 60-bbl "dumps" through a completely mechanical system

STANOLIND Oil & Gas Company's new lease automatic custody transfer system has been put into regular operation. The company's LACT unit is pneumatically controlled—completely mechanical and non-electrical. Its unique design, say company officials, costs less, is simpler in design and operation. The units are factory-fabricated and assembled.

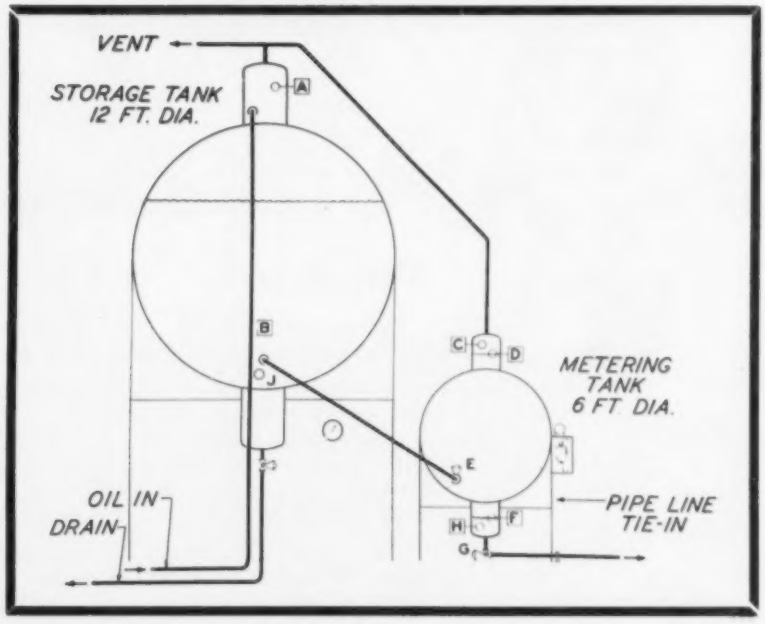
Actual runs of oil have already begun through the first unit and plans are underway for the installation of new systems in West Texas, the Texas Gulf Coast area, and southern Montana.

In the last two years considerable development work has been done by several oil companies, to design a system that makes the operation of "custody transfer" entirely automatic. Several systems now in operation are a result of this effort.

Stanolind's lease automatic custody transfer unit is simple, reasonably priced, factory fabricated and assembled, and requires no electrical power.

"These features result in greater dependability and accuracy, as well as reduced installation and maintenance cost," Frank Lindeman, Jr., Stanolind vice president, production, pointed out.

Development of the new system — which is pneumatically controlled — means that oil on many leases can be produced, its gas and water separated out, directed into tanks, gaged, graded and run — completely automatically. The device has been successfully tested over the past several months.




**Flow diagram** of Stanolind's unit shows the simplicity of the automatic device. Produced oil flows into larger elevated tank. At a pre-set time each day, valve E on the 60-bbl metering tank opens to start day's run. When oil level rises to float D in metering tank, valve E closes and pipe line valve G opens, to allow the metering tank to empty. An electronic water-cut detector, J, prevents bad oil from being dumped. Safety floats C and H automatically shut down unit if liquid level rises too high or drops too low in the metering tank.

The unit was designed by Ralph W. Hill, senior mechanical engineer in the Tulsa office.

Stanolind's automatic custody transfer system uses a 400-bbl storage tank mounted on an elevated structure, a 60-bbl "metering" tank and a series of gas-operated and float-controlled automatic valves.

**How it works.** To begin the operation, oil from the separator enters the large tank. A pre-set 31-day clock starts the day's run by opening the inlet valve to the metering tank. The metering tank fills by gravity. When the level reaches the upper float, four things happen almost simultaneously: (1) The inlet valve to the metering tank closes; (2) the outlet valve to the pipe line opens; (3) the oil temperature is recorded and totaled, and (4) an oil sample is stored in a small

**Controls, sampling vessel** and recording mechanisms are located in this box near metering tank. Run tickets are computed here once a week, once a month or whatever period is convenient. Volume of flow into the pipe line, temperature of each dump and average temperature are recorded. A sample of each dump is stored and an electronic water-cut detector checks against running subgrade oil.

tank. No "bad" oil is allowed to enter the metering tank, since a battery-powered electronic "water cut" detector can be arranged either to automatically divert the oil through the treater or shut down the lease if oil quality drops below minimum standards.

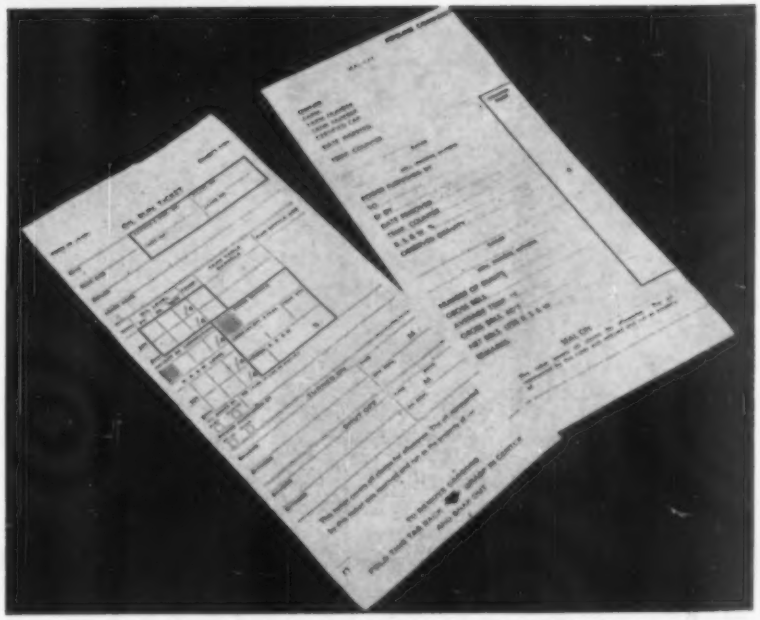
When the oil level falls to the bottom of the metering tank, a counter registers one 60-bbl "dump," the outlet valve closes and the inlet valve to the metering tank opens to repeat the entire process.

When oil in the main tank is insufficient to completely fill the metering tank, flow to the metering tank stops and the main tank refills with the preset clock next sets off the automatic process.

When the pumper and gager make their once or twice-a-month visits to the tank battery, they mix the stored samples of oil with a gas-driven motor mixer to determine the average gravity and sediment content of the oil that has run since the last check. Then they sign the "run ticket," on which is printed the number of "dumps" of oil delivered.

Oil can be stored, measured, and run at 12 psi in this unit, appreciably increasing the amount of salable oil.

**Applications.** The device isn't practical for all locations — at least not right away, according to company engineers. But they do look for it soon at locations now partially automatic (principally automatic well production, testing and tank switching).



**Run tickets—old and new.** The old ticket (left) gives information about the run of usually up to 500 bbl from one tank. The new run ticket (right) records from about 60 bbl (one dump) up to any number of dumps. Tank charts are eliminated along with much of the ponderous clerical work.

"You have to consider economic factors in every installation," Lindeman explains. "Most of this is involved with cutting down costs of labor, maintenance and depreciation. On many consolidated leases, the unit will allow further reduction in tankage facilities, and the sale of excess tankage will pay for automatic equipment."

The trend toward automation on producing leases started about 40 years ago with the installation of automatic switches to start and stop well motors. Such installations grew rapidly with extension of electric power to lease locations.

Automatic storage-tank filling and switching was introduced only nine years ago and is already in wide use, as is automatic well testing. But automatic custody transfer on a working basis is only about a year old. ★ ★ ★

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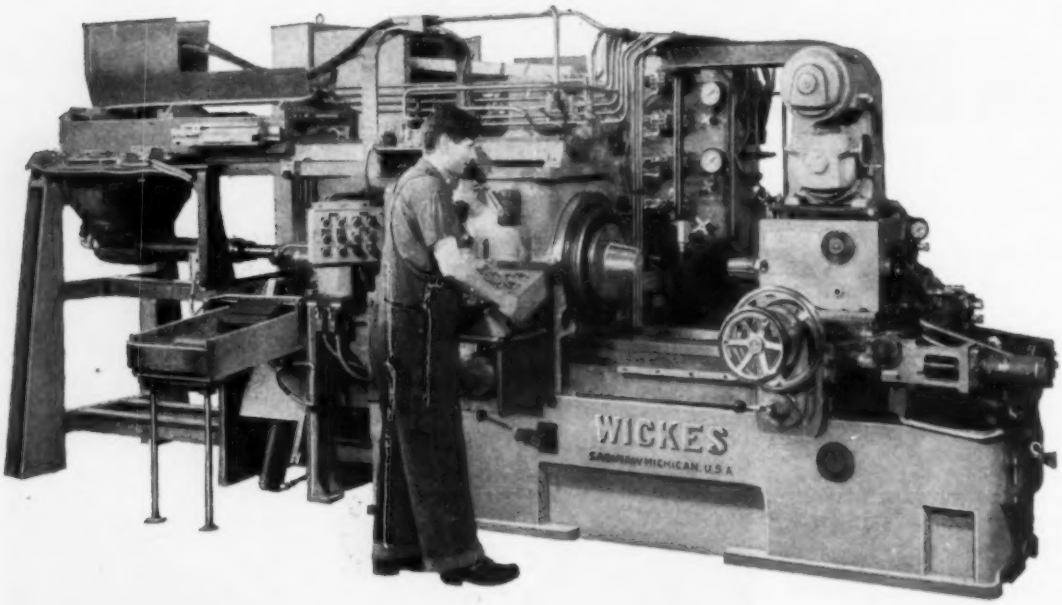


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3. Crew members should not be allowed to become complacent to the ever-present danger of a blowout.

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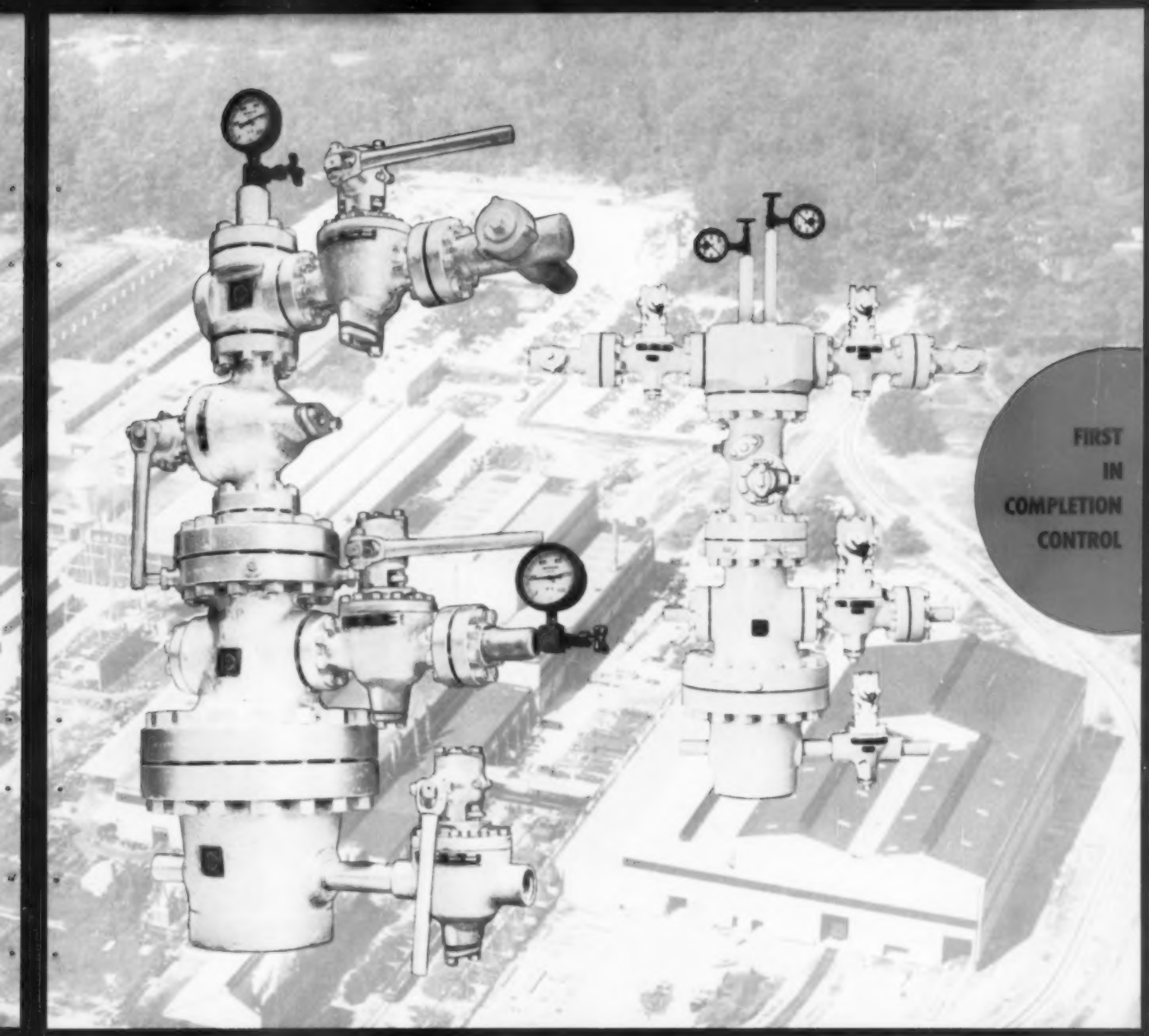


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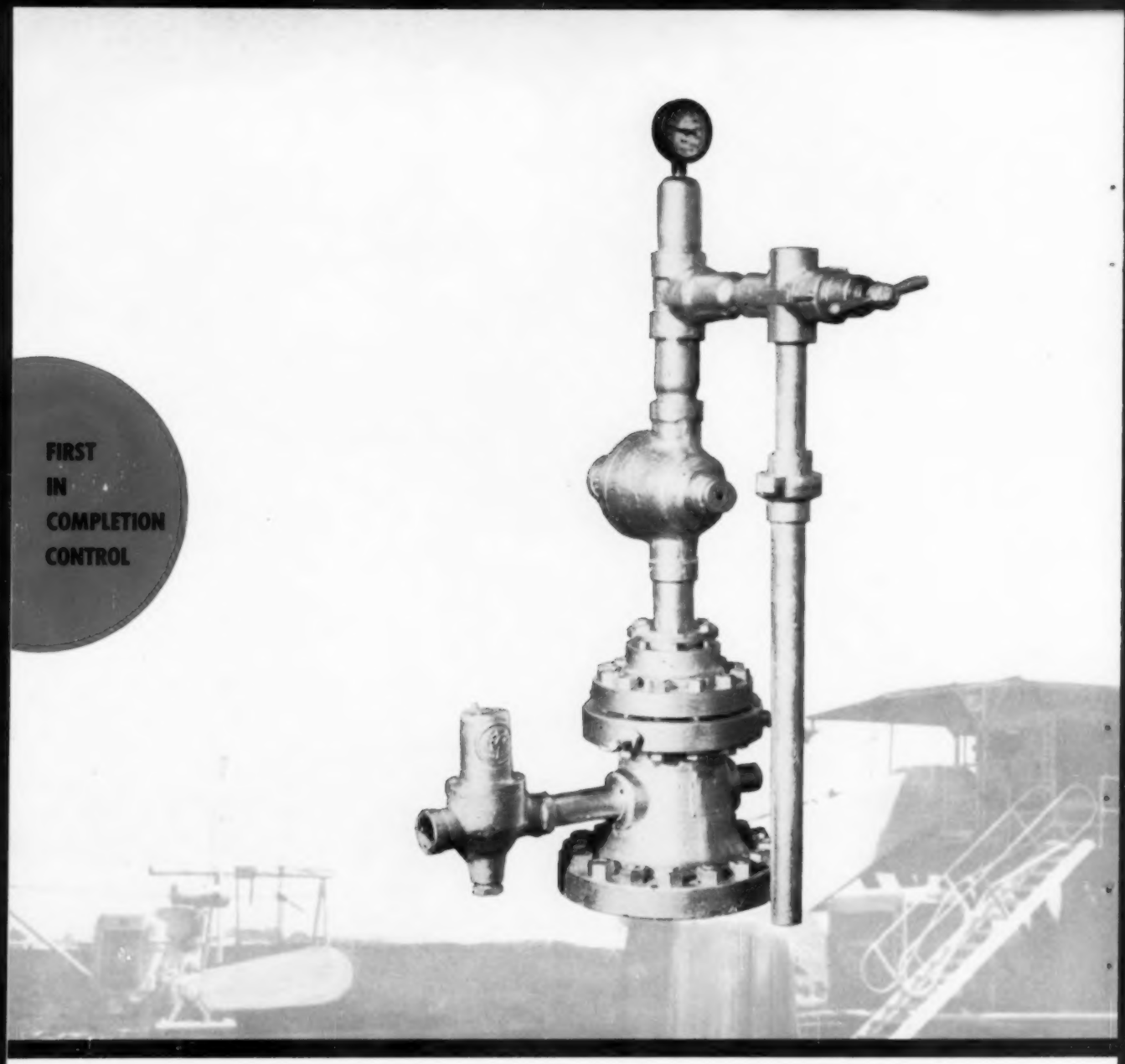


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P 500.

# CORROSION PREVENTION In Gas Condensate and Sweet Oil Wells

**Causes and detection of corrosion in tubing, casing, and other well equipment . . . Fundamentals of determining extent of corrosion and economic use of materials, methods and inhibitors to prevent damage**

**Morris Bock**
*Sun Oil Company, Dallas, Texas*

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"THAT string of rods just wore out" or "that string of tubing just wore out" are expressions which were used for many years to describe corrosion of rods and tubing. Very little consideration was given to the causes of these "wearing out" processes before World War II. The shortage of steel and tubular goods resulting from the war effort dictated conservation of these items to the utmost. Emphasis, therefore, was directed toward finding out how to prevent or alleviate the premature corrosion loss of steel in the oil and gas industry. Beginning in 1944 industry-wide cooperation through various committees made it possible to attack this corrosion problem with the best brains of many oil and gas producers. This made possible a most rapid advance in the field of corrosion technology with the result that in a relatively short period of time corrosion in oil and gas wells was under reasonable economic control.

It is the intent of this paper to discuss some of the fundamentals of corrosion and its alleviation in gas-condensate and sweet oil wells. For the most part, these fundamentals represent previously published findings of Committees T-1B and T-1C of the National Association of Corrosion Engineers and the Corrosion Research Project Committee of the Natural Gasoline Association of America. Prior to discussing this subject matter the following points should be understood.

1. Carbon dioxide is the principal corrodent in the oil and gas wells under discussion although other corrodents usually are present.

2. It is not within the scope of this paper to discuss corrosion caused by production of "sour" oil or gas although carbon dioxide might contribute to the severity of such corrosion.

3. The sweet oil well corrosion to be discussed below may also be referred to as water dependent sweet oil well corrosion.

4. Any reference to gas well corrosion in this paper represents almost exclusively gas-condensate wells rather than dry gas wells.

5. No corrosion of the nature to be discussed can occur unless water is produced along with the oil or gas.

## Sweet Oil Well Corrosion

**Magnitude of the Problem:** The latest survey of the T-1C Committee shows that 17 per cent of the oil wells and 37 per cent of the oil fields which were investigated are considered to be corrosive and representative of water dependent sweet oil well corrosion. The table below shows the scope and extent of this survey:

| AREA | OIL FIELDS | OIL WELLS | CORROSIVE FIELDS | CORROSIVE WELLS |
|---|---|---|---|---|
| (1) Texas Gulf Coast | 440 | 11,749 | 170 | 2,350 |
| (2) Louisiana Gulf Coast & Mississippi | 165 | 4,110 | 50 | 530 |
| (3) N. Louisiana, Arkansas & East Texas | 71 | 11,818 | 33 | 1,870 |
| (4) Others, (Illinois, No. Texas, California) | ? | 1,510 | ? | 85 |

**Why These Oil Wells Corrode:**

In general, corrosion in oil wells depends upon:

1. The water to oil ratio.
2. Rate of production.
3. Method of production.
4. Amount of carbon dioxide and organic acids in the water.

The water to oil ratio varies from field to field. The percentage of water may be as low as 10 per cent in high pressure oil wells to as high as 70 to 85 per cent in low pressure pumping and gas lift oil wells. The 70 to 85 per cent is the limit range for the East Texas field. In most fields, this percentage is between 40 and 60 per cent.

It is quite apparent that the degree of corrosion will depend on both mass and linear velocity. The greater the production, the more corrodent there is to attack the pipe. By the same token, as production increases, linear velocity will increase and result in removal of natural inhibitors or protective scales which may tend to deposit on the walls of the tubing. Another factor to consider is increase in temperature of produced fluids which occurs at high flow rates.

Gas lift accelerates the attack because of (1) carbon dioxide and moisture which may be in the gas lift gas, (2) impingement and (3) velocity effect.

The principal corrodent seems to be carbon dioxide with the probability that organic acids contribute to the severity. The corrosion resulting from carbon dioxide attack occurs

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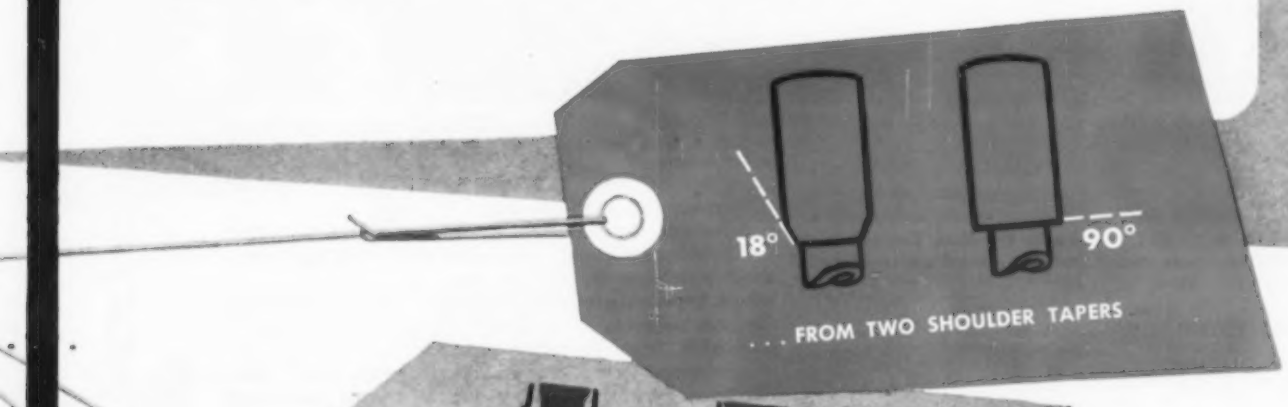


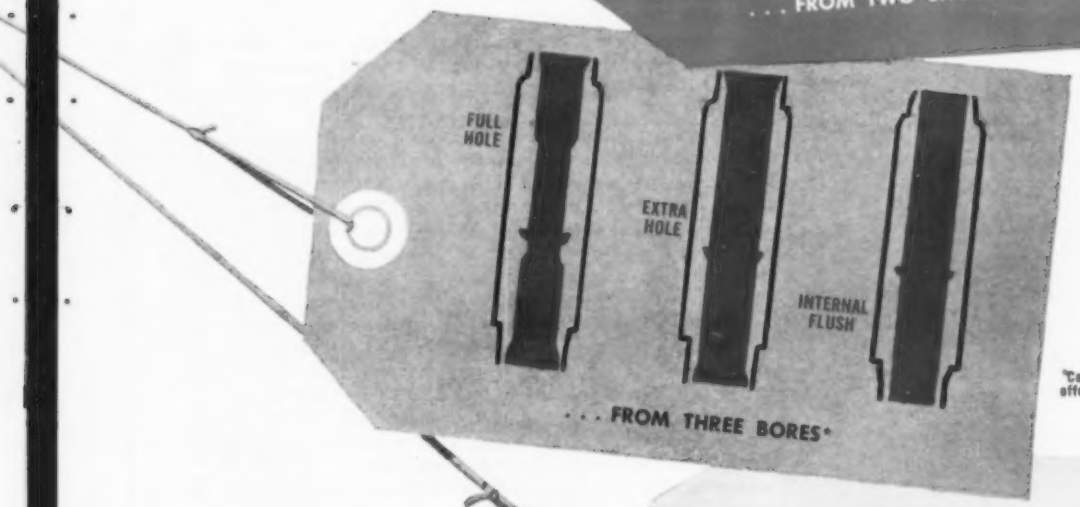


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principally in the form of pitting. Furthermore, the pattern of attack usually exhibits a much higher corrosion rate at bottom-hole conditions than at the surface. This situation, in all probability, is the result of higher concentrations of carbon dioxide in solution at bottom-hole pressures than at surface pressures.

**How to Determine if an Oil Well is Corroding:** Several sources of information are available for determining if an oil well is corrosive. These are: (1) Equipment failure records, (2) iron content of produced water, (3) water and oil production data, (4) coupon exposure tests, (5) caliper surveys and (6) flow line and well head inspections.

Corrosion engineers will argue about the value of any one of these methods except Item (1) "equipment failure." If, however, one is charged with prevention of corrosion before it becomes of economic importance, the latter five methods offer some means to this end. Unfortunately, however, it usually requires more than one of the latter five methods to determine if one has corrosion. Furthermore, it is difficult to set limits for these corrosion detection methods. For example, the amount of iron produced from a well may be comparatively small and yet the well might be corrosive, and vice versa. If uniform corrosion is taking place, a fairly high iron content may be tolerated. On the other hand, an insidious localized pitting type corrosion may be taking place and yet a low iron count will exist.

In a preceding paragraph the variation in critical water oil ratios was mentioned. Although a rather wide variation exists from field to field, fairly narrow limits may apply to a particular field: For instance, in the East Texas field it has previously been stated that the critical water-oil ratio is between 70 and 85 per cent.

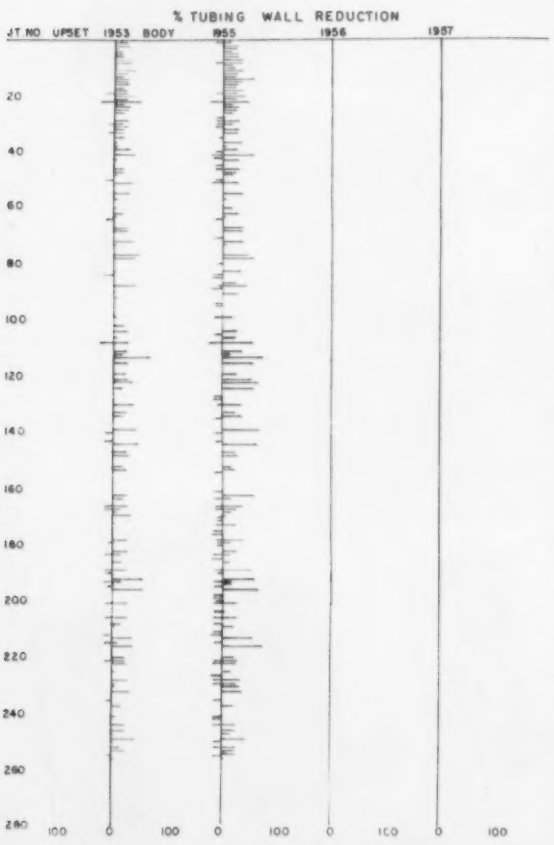


**FIG. 1. Multiple tubing caliper runs provide a graphic picture of tubing corrosion. Survey made in 1955 shows considerable increase in pitting compared with caliper survey made in 1953.**

**FIG. 2. Excessive corrosion found in fitting during routine well head inspection. Discovery also lead to the location of badly corroded tubing in the well.**

Some engineers feel that the coupon exposure method for detecting corrosion is of no value while others place reasonable reliance on the data that coupon exposure tests afford. Experience indicates that coupon data can be reliable in some instances while in other cases it may be totally unreliable. It should suffice to state that the coupon exposure technique can be a valuable tool where its reliability has been established. Such reliability can be established only by correlating coupon data with actual corrosion damage.

The tubing caliper survey represents a very reliable tool for determining corrosion damage. Maximum benefit from caliper surveys is obtained when comparative surveys are made. The need for comparative surveys is caused by the variation in pipe size allowed by API specifications. The caliper tool measures only the variations in internal pipe diameter and such variations may partly result from the tolerance allowed by the API. Therefore, maximum benefit is obtained when one compares the condition of pipe on successive runs instead of using a single run as a guide. As an example, Fig. 1 represents a graphic presentation of the progress of corrosion damage found on tubing caliper surveys made on a well in 1953 and again in 1955. On the left side of each vertical line the per cent of wall reduction in the upsets is recorded and on the right side the per cent of wall reduction in the body of the tubing is recorded for each joint showing corrosion damage. One can readily see that the 1955 survey shows considerably more corrosion than the 1953 survey. Pitting damage in the upsets on the 1955 survey are about three times as prevalent as in the 1953 survey. Furthermore, the pitting in the body of the various tubing joints as recorded on the 1955 survey is deeper in almost every case than pits recorded for the same joints on the 1953 survey.

Periodic inspection of well head fittings and flow lines can serve as a fairly reliable tool for predicting severity of corrosion. Certainly if one finds evidence of serious corrosion on such inspections he should suspect that down-the-hole corrosion may also be taking place. As an example, Fig. 2 represents significant corrosion damage in a well head fitting. This damage was found on a routine well head inspection. As a result, the tubing was calipered and found to

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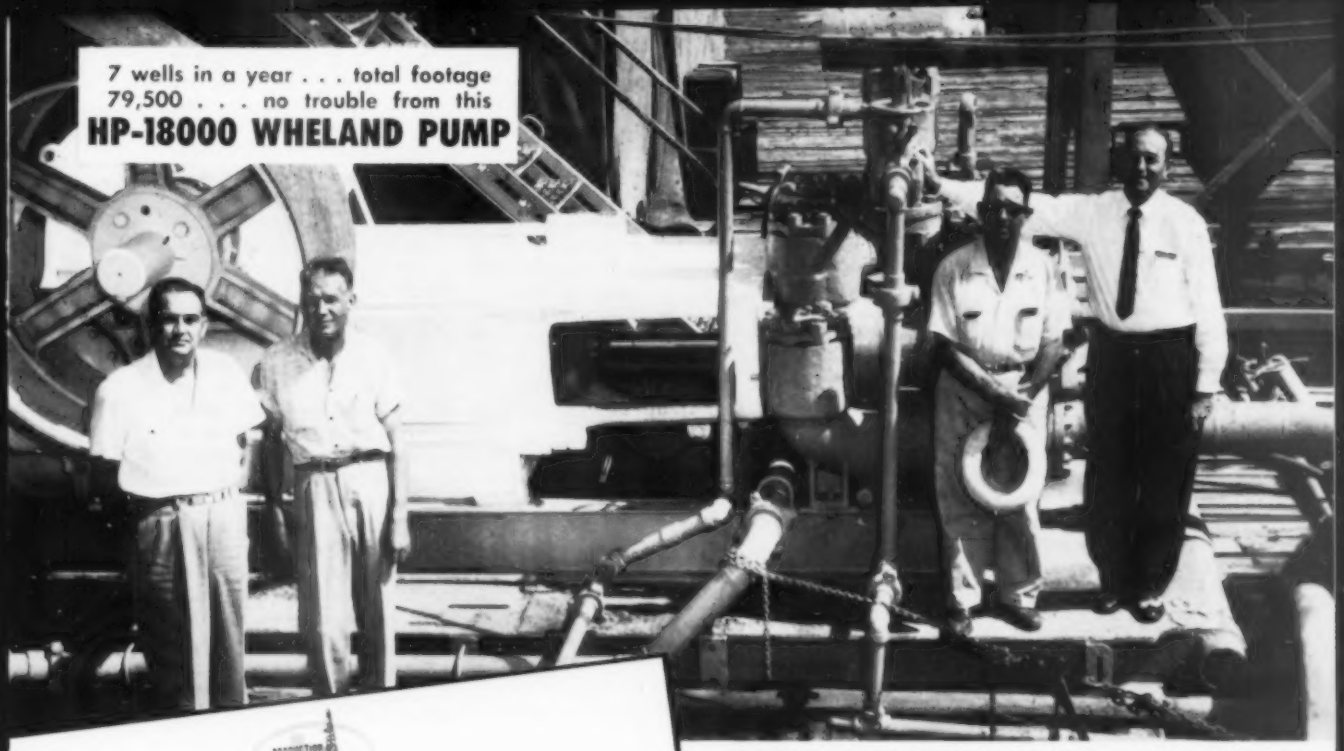
# HP-18000 WHELAND PUMP



Installation view of the Wheland HP-18000 owned by Oil Production Maintenance, Inc., Houston, Texas. Left to right: Messrs. J. K. Butler, President; Tracy East, Wheland Serviceman; "Pop" Woods, Tool Pusher; Harris Lodge, Homco Salesman.

OIL PRODUCTION MAINTENANCE, INC.
1440 CHOCOLATE BAYOU ROAD — P. O. BOX 14291
HOUSTON 21, TEXAS

September 13, 1956

Mr. Gordon P. Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

Oil Production Maintenance, Inc. owns and operates two Wheland power pumps. One is a HP-14000 Wheland and the other is a HP-18000. Both of these pumps have been in operation approximately twelve months. We have experienced no difficulty either with the power end or the fluid end of either of these pumps over this period of time. Both of these pumps have been operated within approximately ten per cent of their rated capacities for the full twelve months.

During the twelve months period, the rig which operates the HP-18000 Wheland has drilled seven wells. They have varied in depth from 10,500 feet to 15,000 feet. The total footage accumulated by this rig during this time has been approximately 79,500 feet. We hope, and have every reason for our belief, that the pumps will continue their efficient operation for several years to come.

Yours very truly,

OIL PRODUCTION MAINTENANCE, INC.

J. K. Butler

J. K. Butler, President.

JKB:ml

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be damaged. Periodic well head inspections can also be most valuable from the standpoint of detecting increases in rate of corrosion between inspections.

Too much emphasis cannot be placed on the importance of accurate records in determining the progress and economic significance of corrosion. It behooves the corrosion engineer to prepare a diary on each well. Such a diary should include as much of the aforementioned data as is required. With an adequate and accurate diary one can readily note changes in coupon weight losses, iron contents, produced water, and any of the means he has for detecting corrosion. Records of equipment failures are most important. The importance of equipment failure records stems from the fact that these data are the means of applying economics to the corrosion picture. There may be cases where it is cheaper to let a well corrode than to spend the money to prevent it. As an example, experience indicates that it costs $200 or more annually to treat an oil well with chemical inhibitors. Obviously, if replacement of corroded materials costs less than this figure there would be no incentive to treat. By keeping adequate records one has an accurate picture of whether or not corrosion is costing enough to warrant doing something about it. Fig. 3 is an example of one means of keeping records of equipment failures on each well. It takes only a casual inspection to note that tubing and rod failures were quite prevalent in this well for the first six months of 1954. In addition, one pump failure is recorded. The letter "C" under each recorded failure indicates a corrosion failure. It was obvious that corrosion of economic significance was occurring in this well. As a result the rods and tubing were pulled in July for an inspection. At that time 50 rods were replaced and inhibitor treatment started. The beneficial effect of inhibitor is readily recognized since only one corrosion failure was recorded for the second six months as contrasted to eleven failures the first six months prior to treatment. Furthermore, frequency of equipment failures can be logged from period to period and this information correlated with data on other corrosion detecting methods in order to predict accurately when corrosion of economic significance might occur. For example, let us suppose that our well diary shows a gradual increase in produced water together with an increase in iron content. Let us further suppose that coupon weight losses also show a gradual increase and that failures of rods and tubing begin to appear. It is then rather certain that the diary is showing the beginning of serious corrosion. Suffice it to say that one should start treating to prevent or alleviate the corrosive condition. This example, of course, is an idealized case since such correlations are the exception rather than the rule. It is highly probable, however, that two or more of the means we have for detecting corrosion will show some correlation.

**How to Prevent Sweet Oil Well Corrosion:** Fortunately, it is no longer necessary to accept corrosion damage as an in-

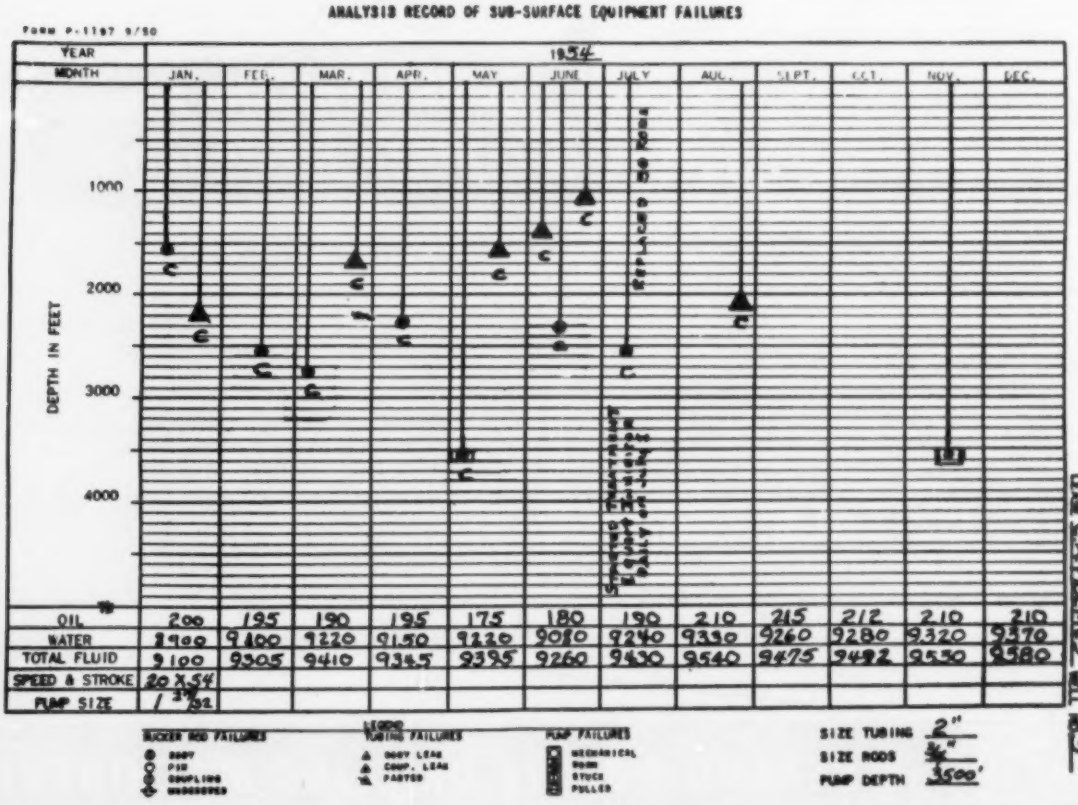


FIG. 3. Too much emphasis cannot be placed on the importance of accurate records. Above is one means of graphically keeping track of equipment failures and causes.

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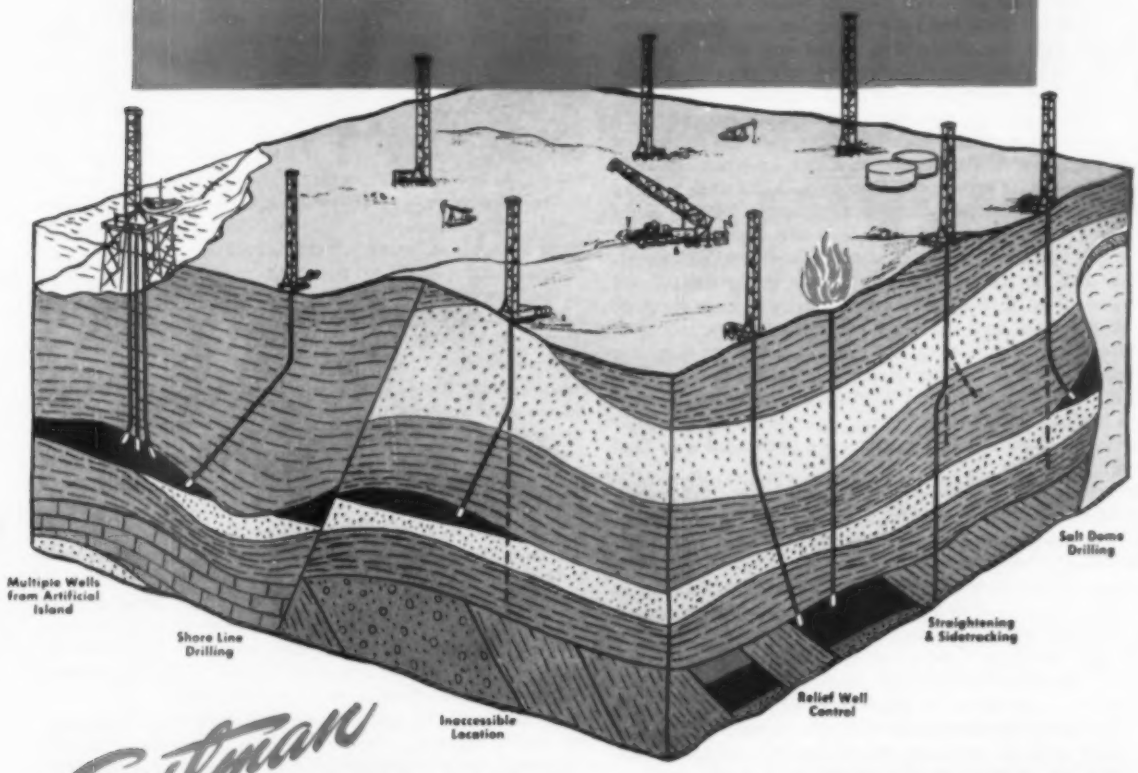


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evitable operating cost. During the past few years the problem has been attacked as follows:

(1) By use of chemical inhibitors.

(2) By use of protective coatings.

(3) By selection of proper equipment.

(4) By practicing proper operating techniques.

(5) By use of corrosion resistant alloy materials.

Although alloy materials may be useful in some cases, their use in oil wells has been rather limited. Some operators have used low alloy nickel (5 per cent or less) tubing and rods. In a few special cases, 9 per cent nickel and 9 per cent chromium tubing has been used where special physical requirements and corrosion resistance were necessary. In these cases, abnormally high pressures dictated the use of these costly materials. In general, alloys have not met with economic success in oil wells. Their use in gas wells is more widespread and further discussion of alloys will be made below in the chapter on Gas-Condensate Corrosion.

Proper operating techniques can materially reduce corrosion damage. This is particularly true in the case of rod pumped wells. Rod stresses and pump rates must be kept within proper bounds because corrosion may be aggravated. Periodic dynamometer surveys should be made to maintain proper operations. Internal casing corrosion may occur below the tubing in high fluid level wells where the pump is set a few hundred feet off bottom. In these cases it is good practice to use a tailpipe down to the perforations or bottom of the hole.

In recent years the development of tools for dually completing wells has made rapid strides. This has created a desire to use dual wells because of the economic advantage. The difficulty of treating for corrosion in dual wells poses a problem. Suffice it to say that the economics of dualing in a known corrosive area should be carefully weighed against the potential cost of corrosion.

Proper equipment selection can materially affect the corrosion picture. For instance, gas lift operations aggravate the corrosion problem. In those cases where gas lift offers no great economic advantage over other methods of pumping, it is wise to evaluate the corrosion aspects of each method and let the economics of corrosion be the deciding factor.

The use of protective coatings for prevention of corrosion in oil wells is fairly limited. On the other hand, protective coatings are in fairly common usage in gas wells and they will be more thoroughly discussed in the chapter on gas well corrosion. In general, the economics of protective coatings for oil well tubular goods is not particularly good. On the other hand, in wells difficult to treat with inhibitors, such as gas lift, high pressure and extremely high water producing oil wells, coatings may compete favorably with inhibitor treatment. Coatings are occasionally used in pumping wells. Major disadvantages of coatings can be summed up as follows: (1) they are easily damaged by the usual wire line tools which occasionally must be run, (2) imperfect coatings may result in serious localized corrosion at the points of imperfection and (3) coated tubing does not eliminate the need for inhibitor treatment to protect the tree and flowlines unless these items are also coated or otherwise made corrosion resistant. At the present time the most successful tubing coating is the baked phenolic. Recently the air dried epoxy and phenolic epoxy materials have come into use. Although the footage of these materials in present use is appreciable, it is still too early to attempt an evaluation.

The popularity of chemical inhibitors for use in preventing oil well corrosion has been and continues to be phenomenal. In the past decade the oil well inhibitor manufacturer field has grown from one company to at least twelve majors and probably dozens of small localized companies. Several major oil companies are either formulating their own compounds or are farming out the formulation to chemical manufacturers. There are two classes of chemical inhibitors; the inorganics and the organics. The inorganics are used to such a small extent in oil wells they are being mentioned only in passing. Examples of the inorganic type of inhibitor are arsenical salts. These materials seem to have much more popularity in California than in other oil producing areas. Probably their lack of popularity in most areas stems from the fact that (1) arsenic salts in extremely small quantities will poison refinery catalysts and (2) they do not offer the lasting effect of the organic materials. Organic inhibitors are manufactured in both solid and liquid forms. The liquids are compounded to obtain various degrees of solubility or dispersibility, for instance, one can purchase the following types: (1) oil soluble, water insoluble, (2) oil soluble, water dispersible, and (3) water soluble, oil insoluble. Recently formulations of weighted liquid organic inhibitors have been placed on the market for those cases where high annular fluid levels exist. Solid inhibitors are manufactured in the form of sticks or pellets. The solid inhibitors are used mainly in (1) high fluid level wells, (2) wells set on a packer, (3) isolated well locations where stick injection is simpler than liquid injection and (4) cases where liquid inhibitors may not do the job. The greatest objection to the use of solid inhibitors is that they oftentimes bridge and there is no assurance that they get to bottom.

The question of whether to use a water soluble or oil soluble compound as an inhibitor in a particular well is still controversial. Some operators prefer to use a water soluble or water dispersible inhibitor when the water to oil ratio is greater than 1 and an oil soluble inhibitor when the ratio is less than 1. Other operators take the opposite view. In all probability it makes very little difference which type of compound is used so long as returns of the chemical are obtained. In high fluid level wells, the water dispersible or water soluble type of compound may offer greater assurance of inhibitor returns than an oil soluble type.

By and large, the great majority of inhibitors on the market today are doing an excellent job. The trend, however, is toward batch treatment at intervals up to 3 or 4 weeks instead of daily treatment as practiced in the past. This trend will undoubtedly cause condemnation of some otherwise good inhibitors which do not possess lasting qualities.

One of the major problems connected with the use of inhibitors is the inability to get the chemical to the bottom of the tubing in many wells. This is particularly true in high pressure wells where tubing is set on a packer. Recent developments to assure proper placement of inhibitor include wire line dump bailer and go-devil temperature actuated dump bailer. Fig. 4 shows a recently developed dump bailer which operates by means of a collar finder trip mechanism. These tools offer a means of adequately treating wells which previously could not be adequately or economically treated. Prior to these developments, methods of assuring placement of inhibitor in high pressure oil wells involved the use of bottom-hole chemical injector valves and special small diameter strings of pipe through which chemical could be injected. Both these latter methods are rather expensive as well as hazardous in many cases and have had very limited application.

### Gas-Condensate Well Corrosion

**Magnitude of the Problem:** In 1951 it was estimated that 45 per cent of all gas-condensate wells in the five state

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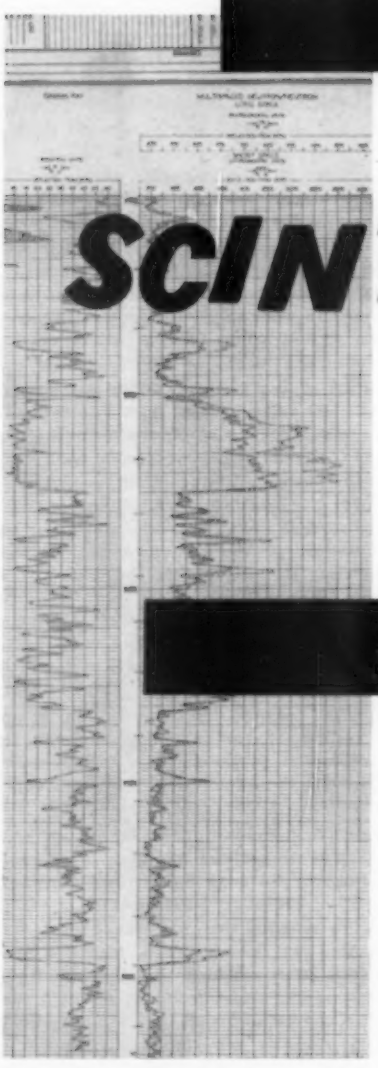

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Southwest area, consisting of Texas, Louisiana, Oklahoma, New Mexico and Mississippi, were corrosive. This figure was obtained from a survey by the NGAA Committee, representing over 2400 gas-condensate wells of which more than 1100 wells were considered corrosive. Only 27 operators were represented in this survey. It is a certainty, therefore, that the actual total number of corrosive wells in 1951 was far in excess of 1100. Unfortunately, no figures are available on the actual number of corrosive condensate wells at the present time. One might rationalize by applying the 45 per cent figure to the total number of gas and gas-condensate wells in the Southwest Area. Since there are approximately 20,000 of these wells in the five state Southwest Area, one would come up with a figure of 9000 corrosive wells. This, of course, represents a maximum since a

**FIG. 4. Dump bailer used to inject inhibitor down-the-hole. This unit has a capacity of 2½ quarts and is released by a collar finder trip mechanism that releases the chemical agent at the desired depth.**

significant percentage of the 20,000 wells are gas wells and not gas-condensate.

**Why Gas-Condensate Wells Corrode:** As a general statement, one might simply state that corrosive gas-condensate wells get that way because they produce acid water. The acidity is caused by carbon dioxide and organic acids with the latter serving in a minor role as a corrodent. The carbon dioxide is present in the gas phase of all corrosive gas-condensate wells. It dissolves in water (brine or condensed water vapor) which is present in all corrosive gas-condensate wells, to form carbonic acid. The severity of corrosion often varies directly with the amount of carbon dioxide present in the gas.

The majority of gas-condensate wells falling into the following categories are potentially corrosive:

1. A depth greater than 5000 ft.
2. A bottom-hole temperature in excess of 160F.
3. A bottom-hole pressure in excess of 1500 psi.
4. A production rate in excess of 2 MMCF per day.
5. A carbon dioxide partial pressure greater than 30 psi.
6. A pH of less than 5.4 in wellhead water.

**How to Determine if a Gas-Condensate Well is Corroding:** In the sweet oil well corrosion section, six methods were listed for determining if an oil well was corroding. All these methods apply to gas-condensate wells with the exception that gas-condensate wells exhibit no critical water to oil ratio. Two additional methods can be added to that list. These are (1) pH of well head water and (2) carbon dioxide content of the produced gas.

The methods which apply to both oil wells and gas wells were discussed in the first section, and will not be repeated here. The importance of pH of well head water samples and carbon dioxide content of the produced gas, however, merits further discussion. It was stated above that one of the criteria of gas-condensate well corrosion was a produced water pH of less than 5.4. This pH value represents a reasonably strong acid condition. More important, it actually represents a much higher acidity than that measured because a sample of water taken from a well contains much less carbon dioxide than is present in the water in the tubing at operating pressures. In general, the greater the pressure, the more carbon dioxide will be dissolved in water and the higher the carbon dioxide content, the higher the acidity. The acidity of water under operating pressure may be 10 to 100 times greater than that measured on a well head sample. Experiments have shown that the degree of severity of corrosion in gas-condensate wells can be predicted from the partial pressure of carbon dioxide present in the gas phase. For instance, a carbon dioxide partial pressure of 10 psi or less usually causes little or no corrosion. Between 10 and 30 psi there is an indefinite range where corrosion may or may not occur. Appreciable corrosion usually results from partial pressure in excess of 30 psi.

**How to Prevent Gas-Condensate Well Corrosion:** The prevention of corrosion in gas-condensate wells, although generally more difficult than in most oil wells, involves essentially the same methods as mentioned in the chapter on oil wells. For instance, the use of chemical inhibitors, protective coatings and alloy materials represents the methods available for prevention of corrosion while proper equipment selection and operating techniques will help toward minimizing the corrosion problems.

One important example of proper equipment selection is the desirability of proper size tubing. It is well recognized that the velocity of a corrosive gas has a significant effect on the severity of corrosion. Several investigators have reported evidence showing that an increase in tubing size to something larger than the usual 2 in. can materially reduce corrosive attack. In one field it was demonstrated that an increase in tubing size from 2 to 2½ in. doubled the amount of gas which could be produced before tubing replacement was necessary. Another important consideration in equipment selection is the use of fully normalized tubing. Such tubing will practically eliminate the ringworm type of corrosive attack so prevalent in gas-condensate well corrosion. Fortunately, in wells treated with corrosion inhibitors, the need for normalized tubing is less pronounced than in untreated wells. On the other hand, normalized tubing may in itself solve a mild corrosive problem without the need for inhibitor treatment.

Proper operating technique dictates that dual completions be used with caution, if at all. The hazard of casing corrosion in a high pressure well of the gas-condensate type cannot be minimized. It, therefore, behooves an operator of a dual well to not only provide for protection of the casing, but also to be prepared to keep the casing under adequate surveillance so that its condition may be known at all times. Another important operating suggestion is to attempt to obtain allowables so as to minimize producing wells at high rates of flow. In many cases this may not be possible but where it can be done, it is advisable to produce operating allowables over a maximum number of days in

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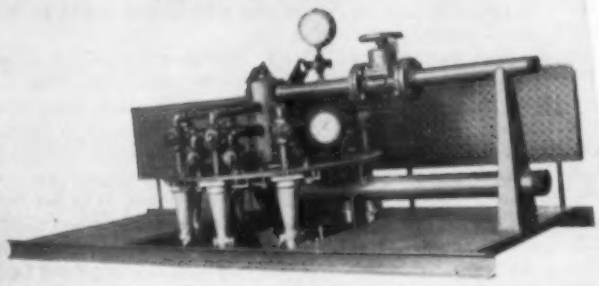

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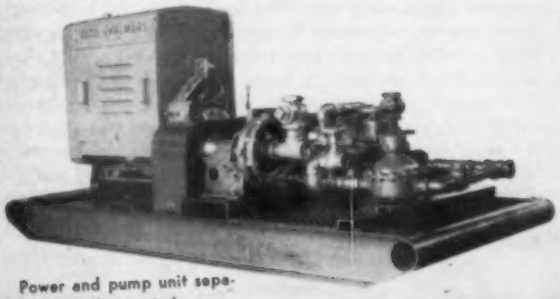

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order to minimize high flow rates.

As a result of test work by the National Association of Corrosion Engineers in cooperation with the Natural Gasoline Association of America, the use of alloy tubular goods such as 5 and 9 per cent nickel and 9 per cent chrome was recommended for their resistance to gas-condensate well corrosion. In the early part of 1948 the first few strings of alloy tubular goods were installed. Since that time, over 200 strings of 5 and 9 per cent nickel tubing have been placed in service. In addition, considerable use has been made of 12 per cent chrome alloy in Christmas trees, tubing hangers and choke beans. In general, the performance of the alloy materials has not been outstanding. The 5 per cent nickel alloy has proved to be no better than API steels. The 9 per cent nickel has performed satisfactorily except that some of the older strings are now showing minor pitting and iron contents of produced water are as high as when API tubular goods were used. Most wells so equipped are now being treated to protect flowlines. It is apparent that these alloy materials offer only a minor role in gas-condensate service and economics seems to indicate that their use should be limited to: (1) wells producing at very high flow rates with expected production to continue for 20 or more years, (2) offshore wells and other isolated wells where chemical treatment may be impractical and (3) high fluid level wells where chemical treatment is difficult.

The first recorded use of protective coatings for prevention of gas-condensate well corrosion was in 1946. At that time, a well was equipped with a string of thermo-setting phenolic resin known as TK-2. During 1946 several other tubing strings were coated with this material. These early strings were not particularly successful because the coating flaked off easily. Furthermore, thread leaks presented a major problem because the threads were coated and it was difficult to make up joints properly. Experience with the early coating jobs dictated changes in coating formulations, application techniques and more careful handling. These changes resulted in much more satisfactory coatings. A survey in 1951 showed that over 80 : rings were in gas-condensate service. A questionnaire to members of the NACE-T-1B Committee early last year indicated that many of the coated strings which were installed from 1946-1948 were now being protected with inhibitors. The conclusion was drawn that although failures had no doubt occurred in parts of the strings, the coating had paid for itself by at least partially protecting the tubing before inhibitor programs were required.

As stated in the discussion of sweet oil well corrosion, new types of coatings such as the phenolic-epoxies and catalyst setting epoxies are in service but insufficient history is available to rate these newer materials.

The use of chemical inhibitors to control corrosion in gas-condensate wells is practically universal except in the few cases where alloys and protective coatings continue to offer protection. The application of inhibitors to gas-condensate wells presents a much more difficult problem than to oil wells because most gas wells are equipped with tubing packers which make it impossible to treat down the annulus. This situation has resulted in the development of tools and techniques to assure getting chemical to bottom. Some examples of techniques are (1) use of "macaroni" strings, (2) use of additional string of tubing for the specific purpose of injecting chemicals, (3) use of chemicals in solid stick form so that inhibitor can be injected directly into tubing and (4) use of special portable high pressure chemical pumps for injecting liquid chemical directly into the tubing. A close up view of a truck mounted high pressure unit used for injection of liquid inhibitors is shown in Fig. 5. All of the above methods and tools have been used to some extent. The least desirable of the above methods are probably the

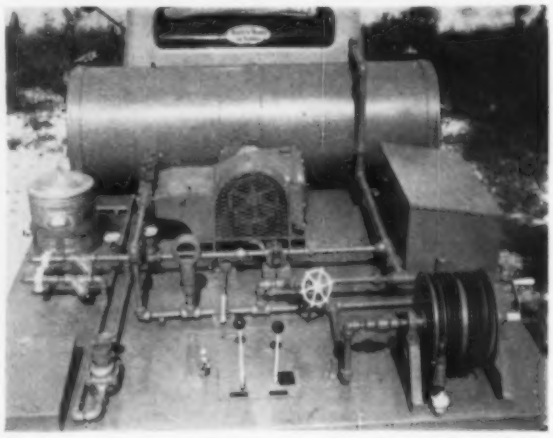

**FIG. 5. Truck mounted high pressure inhibitor injection unit is used to inject inhibitors into casing and tubing against well pressures. Pump shown is rated at 10,000 psi.**

macaroni string and the extra string of tubing because of the hazards involved in using the former and the high cost of the latter. Widespread use has been made of portable high pressure chemical pumps. Many operators are contracting their service while others use their own personnel and equipment. As in all cases where one has alternate methods of performing a job, economics will dictate which of the above methods or tools to use.

Both inorganic and organic inhibitors are used for the prevention of corrosion in gas-condensate wells. The inorganic types, however, are used only in a few fields now where up to about 1951 they were used to a large extent. The reason for this situation is that the organic inhibitors provide more residual protection than do the inorganics and thereby reduce the frequency of treatment. Whether one uses an organic or inorganic inhibitor is usually a matter of economics. The usual inorganic materials are cheaper than the organics but more frequent application is required. One, therefore, must consider the cost of chemical plus the cost of labor to inject it over a period of an arbitrary time interval in order to determine which type to use. Of course, this assumes that both types offer equal corrosion protection. Inorganic agents presently being used are (1) sodium carbonate, (2) sodium bicarbonate, (3) ammonia, (4) chromates and (5) arsenic salts. The organic inhibitors presently in use are too numerous to mention. Suffice it to say that most of them are excellent inhibitors but no one of them has universal application. Some cause undesirable side reactions such as emulsions and deposits in heat exchanger valves and separators. The choice of an inhibitor for a particular well or area can often times be adequately made on the basis of laboratory evaluation but in the final analysis actual field experience will dictate which inhibitor to use for maximum corrosion protection with a minimum of undesirable side reactions.

## Summary

In the foregoing an effort was made to impart some knowledge of the causes and prevention of corrosion in gas-condensate and sweet oil wells. In doing this, the magnitude of the problem, the means of recognizing it, and the methods available for its alleviation have been discussed. Although this corrosion problem is still not completely solved, it has been brought under adequate control in a relatively short period of time. It may further be stated that the importance of applying corrosion engineering principles is now recognized as vital to economic production of oil and gas.

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# TONGS AND POWER TONGS

C. E. Murphy*

TONGS are to the men on the derrick floor what the pipe wrench is to the plumber—a means of making and breaking joints in pipe. However, there is considerable difference in that a plumber can get a pair of 24-in. wrenches for approximately $14, and they will weigh about 10 lb each. On the other hand, a set of rotary tongs may represent an investment of from about $800 to $3500, depending on the size of the tongs and the assortment of lug jaws. The tongs may each weigh from about 100 lb for the smaller sizes up to about 650 lb for the larger sizes. A power tubing tong, complete with trailer mounted air compressor or hydraulic unit, may well represent an investment by the company of from $5000 to $5500.

Rotary tongs are manual tongs (Fig. 1). The range in size varies from that required for tubing to sizes suitable for casing. Each tong can cover a considerable range of pipe sizes by changing the lug jaw (Fig. 2). In use the tongs are suspended in such a manner as to permit them to be swung to the center of the floor for use and swung out of the way when not being used. When making up pipe, the general practice is to use a spinning line in conjunction with the cathead on the drawworks to initially make the pipe up. To tighten, a rotary tong with a cat line is used. When coming out of the hole with drill pipe, the practice is to use two tongs, one anchored as a back up, and a cat line connected to the other for breaking the joint (Fig. 3). After the initial break is made, the lower or back up tong is swung out of the way, and the rotary table is rotated while the upper tong serves as back up.

Power tongs are available in both air and hydraulic powered models. (Fig. 4 shows an air model.) For the most part, they are called tubing tongs in that they usually range up to about 4-in. OD capacity. Larger sizes suitable for casing are available, but they are usually obtained on a rental basis. The power tubing tong provides a rapid means of making joints in that they eliminate the use of the spinning and cat lines and provide a means of tightening the joints to a specified torque. The capacity of the power tongs is large enough to permit them to be used on the drill pipe in slim hole drilling, and they are being employed to a considerable extent in that manner. Power tongs are reversible and have two speeds—high for spinning and making up, and a low speed for breaking out. One manufacturer of power tongs points out that they can be used for light drilling, such as drilling out a plug.

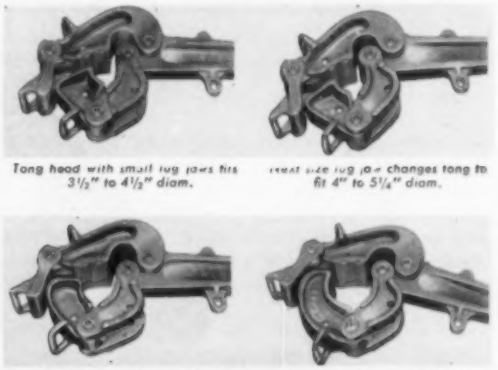
Power for the tongs is provided either from existing air or hydraulic power sources on the rig, or trailer or skid mounted compressors, or hydraulic power units.

Whether the tongs used are manual or power, it should be remembered that the pipe used in oil and gas wells is subjected to severe usage from tensile stresses, and from corrosive and abrasive action. It is, therefore, desirable that the tongs do not crimp, distort, or unduly scar the pipe. It is also desirable that the tongs have the following features: They should be easy to latch and unlatch, yet provide a positive lock while in use; they should be suitable for a wide range of pipe sizes by changing a minimum number of parts, and they should be properly balanced for ease and safety in handling.

At the beginning it was pointed out that the tongs may represent a considerable investment. With this in mind, it should be mentioned that the major manufacturers of tongs maintain repair facilities for their tongs in which they rebuild or replace worn or broken parts, thereby giving the tongs an extremely long life.

Byron Jackson

Fig. 1 Rotary manual tongs


Tong head with small lug jaws fits 3½" to 4½" diam.
Next size lug jaw changes tong to fit 4" to 5¼" diam.
Changing only lug jaw makes tong fit 5" to 7¼" diam.
Next size C-frame tong to take 6⅞" to 8⅛" diam.

Web Wilson

FIG. 2. Wide size range by changing lug jaw.

*Instructor in Engineering, Texas College of Arts and Industries, Kingsville, Texas.

Fig. 3. Two tongs used in coming out of hole with drill pipe.

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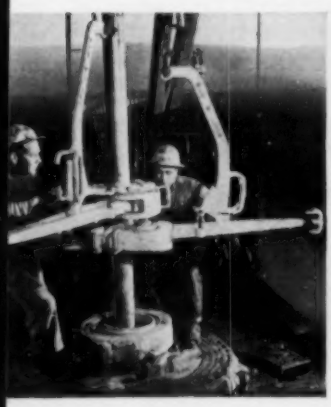
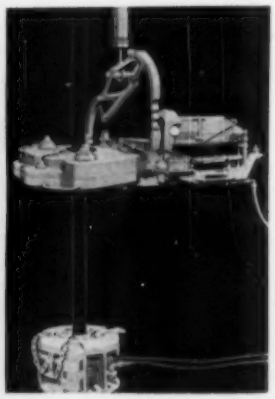


Fig. 4. Air model power tongs.

Byron Jackson



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Tell us about the job and we'll tell you about a Century Motor with the power, the characteristics, and the experience to handle it.

Century specializes in tough electric motors for exacting oil country jobs and J&L Supply men understand their application. If the job is technical we'll work with your engineers, or we'll supply the engineering know-how.

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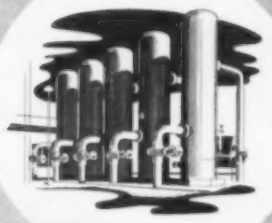
Century Weathergard high torque, high slip motors start and handle pumping units with quiet efficiency in any weather your forecaster can dream up.



Century explosion-proof motors protect life and property wherever an electric spark might be disastrous.

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**SUPPLY DIVISION – Tulsa**

SERVING THE UNITED STATES AND CANADA T-MA

# the Biggest One Yet!

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**CB - 912DA - 168 - 35**

- **14 FOOT STROKE**
- **35000 LB. CAPACITY**
- **912000 IN. LB. PEAK TORQUE**

To fulfill the ever growing demand for longer stroke, greater beam capacity, and more effective counterbalance, Lufkin is proud to present this giant new unit which is capable of handling the heaviest pumping jobs in the field today.

The design of this new 14-footer features the same well known **RUGGEDNESS** and **DEPENDABILITY** which has made LUFKIN units the standard of comparison the world over.

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Lufkin equipment in Canada is handled by THE LUFKIN MACHINE CO., LTD., 9950 65th Avenue, Edmonton, Alberta, Canada 3913 18th Avenue, Regina, Saskatchewan, Canada

# Chalk for the doghouse blackboard is our business, too!

Recently, one of the National Supply Stores that serves an especially active area had several requests for chalk. Toolpushers wanted it for writing on their doghouse blackboards. So we promptly stocked a quality grade of dustless chalk, and it's now "moving" very well.

This is typical of the effective supply service available from every one of our 129 stores. No item is too small when you need it. In fact, we know that good store service on small items — as well as major equipment — is a "must."

Each National Store has a complete line of operating supplies that is tailored to the needs of the area it serves. A store's inventory is never static — but constantly changed to bring you the newest developments in appropriate products. When you ask for an item we don't have (like the chalk), we get it.

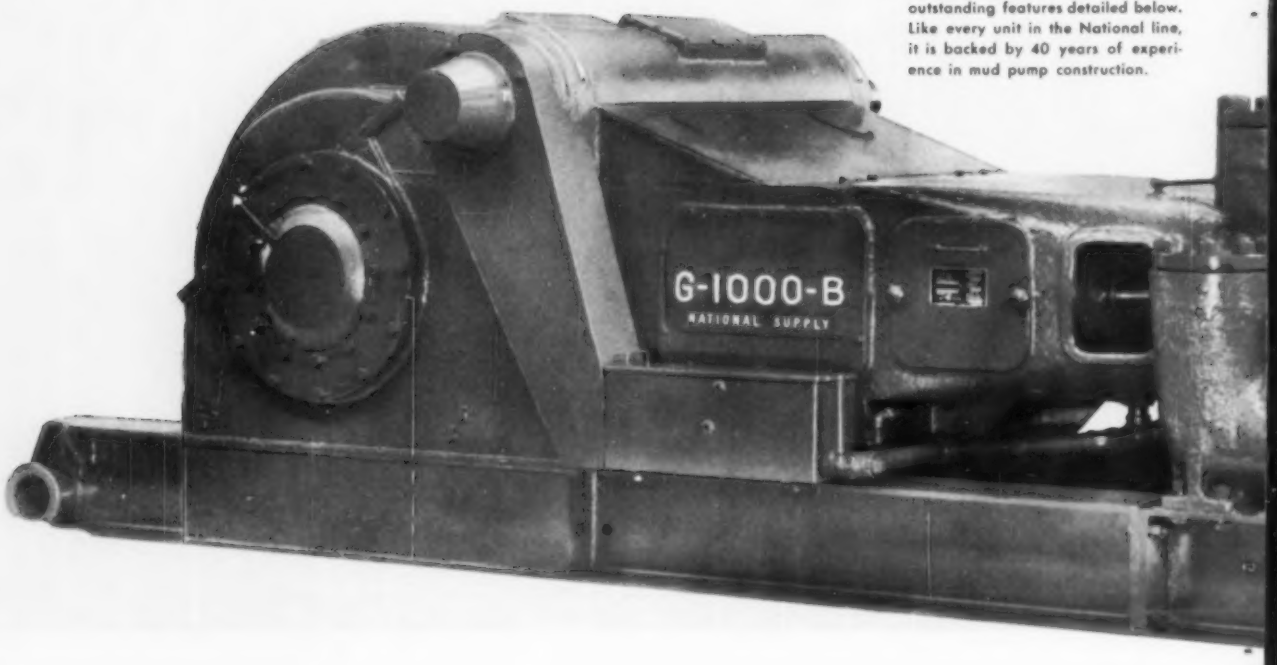
Moreover, we insist on top quality products — from the major equipment in our own "National Blue" products family to the smallest accessory item you can name. And, by anticipating your needs, we always try to eliminate delay and give you the best possible price benefits.

If you haven't stopped in a National Supply Store for a while, you're missing a profitable shopping experience. You can quickly see and select the products you need. Colorful displays and racks of well-illustrated product literature aid you. And you get the reliable personal service that has helped to make us the leading storekeeper to the oil industry.

THE
**NATIONAL SUPPLY**
COMPANY

Lufkin equipment in Canada is handled by THE LUFKIN MACHINE CO., LTD., 3913 18th Avenue, Regina, Saskatchewan, Canada

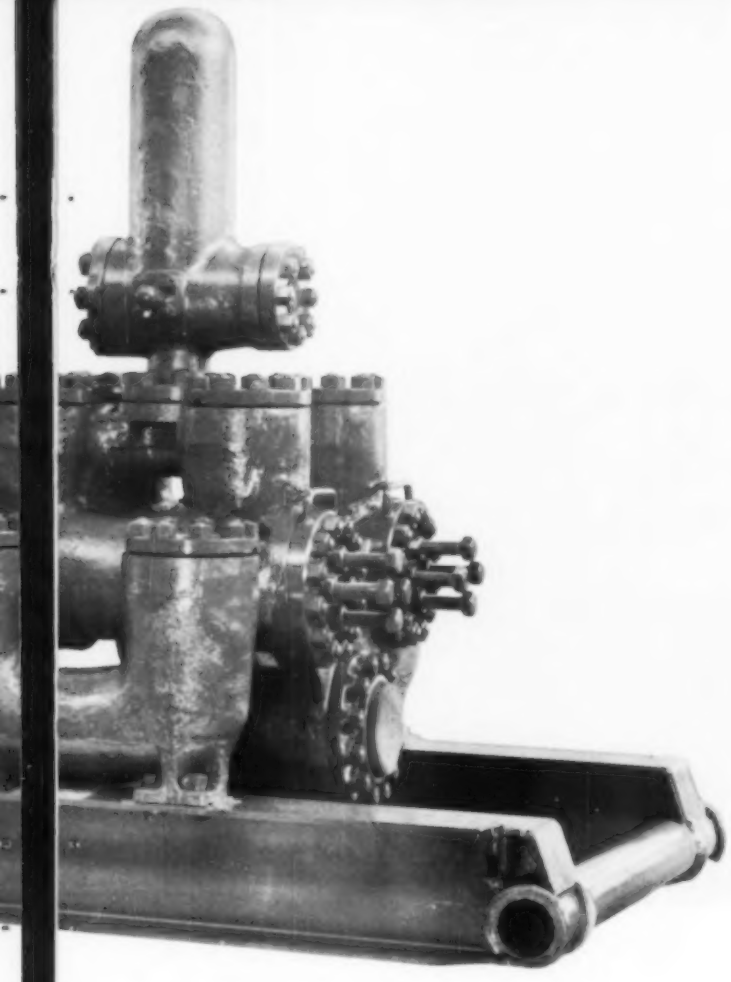
The G-1000-B, largest pump manufactured by National, has all the outstanding features detailed below. Like every unit in the National line, it is backed by 40 years of experience in mud pump construction.




# These National slush pump features

- Advanced design gives greater horsepower per unit of weight.
- Main bearing* and connecting rod bearings are individually and consequently more accurately pre-loaded to reduce impact loading and eliminate slapping of bearings.
- Maximum frame strength with minimum weight made possible by the use of steel plates and steel castings electrically welded into one unit.
- Aluminum main frame cover and crosshead inspection covers.
- Long trouble-free gear life assured by sturdy construction of pinion shaft and crankshaft, minimizing deflection and maintaining proper gear tooth contact.
- Single helical gears. Forged steel pinion integral with shaft, and fully heat-treated fabricated steel gear* shrunk on crankshaft.
- Solid cast steel construction precludes connecting rod failures from loosening of bolts.
- Long life assured by replaceable crosshead slippers and crosshead liners.
- Intermediate rod cannot be accidentally unscrewed from crosshead by operating vibrations or by unscrewing piston rod because of locking pin which positively prevents rotation.
- Simplicity of the installation of the drive sprocket or sheave made possible by a tapered extension on each end of the pinion shaft.
- Grease packed bearings lubricated from outside the pump exclude crankcase oil.
- Gear splash and cascade lubrication eliminate necessity for a mechanical lubricator.
- Mud contamination of crankcase oil positively prevented by intermediate baffle wall and large deflector on the water piston rod lock nut.
- One piece cast alloy steel fluid end with no integral walls or baffles and with cylindrical sections. Minor damages reparable by welding.
- Minimum restriction to fluid flow and elimination of "dead" spaces in the suction assured by single suction connection and large, direct, smoothly curved passages.
- Valve cover plates and cylinder heads are sealed by lip type pressure actuated packing, allowing a metal-to-metal seat

*Patented



THERE'S A RUGGED

# NATIONAL

SLUSH PUMP FOR

EVERY DRILLING NEED!

| Type | Rated Max. Input H.P. | Rated Output H.P. | Rated Speed R.P.M. |
|---|---|---|---|
| D-50 | 80 | 68 | 75 |
| C-100 | 150 | 128 | 75 |
| C-150-B | 220 | 187 | 70 |
| C-250 | 370 | 315 | 65 |
| C-350 | 600 | 510 | 60 |
| G-700 | 700 | 595 | 70 |
| G-1000-B | 1000 | 850 | 65 |

## insure low operating costs!

between these members and the pump body. This design permits uniform stud loads which reduces blowout hazard and stud breakage.

- A.P.I. metal ring gaskets at suction and discharge flanges.
- "Tell-tale" hole gives warning of liner sleeve leakage before any damage is done to the pump casting. No removal of any parts necessary to tighten liner sleeve packing.
- Type "G-1" NATIONAL valves are designed to provide a minimum of restriction to fluid flow, allowing more complete filling of the cylinders, thus minimizing shock loads on the working parts of the power end.
- "Nationaloy" liners and National Dual Seal pistons offer accurate clearances, excellent sealing action and long life. National "Blue Stripe" or "Blue Chrome" A.P.I. Rods are available in all tapers.
- Special design of skid end permits easy rigging of winch line without damage to skids. Heavy, well placed crossbracing in skids assures rigidity.
- Fluid piston rod stuffing box bores case hardened to retard wear caused by breathing action of the fluid piston rod packing.
- Alemite grease packed fluid piston rod stuffing boxes with Acme-threaded adjusting nut designed to increase the service life of piston rods and piston rod packings.
- Enclosed fluid piston rod lubrication assures longer, trouble-free service from piston rods and piston rod packings.

THE

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COMPANY

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DIVISION OFFICES: Denver; Ft. Worth; Houston; Toledo; Tulsa; Torrance
CANADA: The National Supply Company, Ltd., 200 F. W. Clark Building, 709 Eighth Avenue, West, Calgary, Alberta
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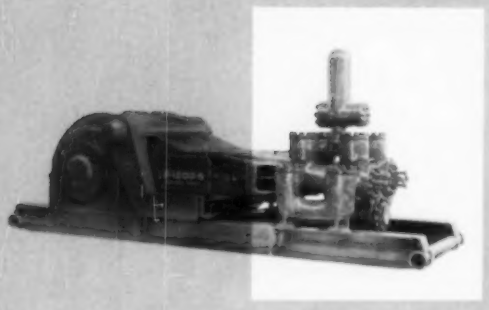
NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

...and National fluid end parts to keep pump maintenance low!

see the next page

# You keep pumping efficiency high with National Fluid End Parts!



Whether you use them in National Slush Pumps or pumps of other makes, you can count on National Fluid End Parts to give long service life, reduce replacement costs and keep pumping efficiency high. For these reasons, precision-made National Fluid End Parts have been important factors for many years in slush pump preventive maintenance programs throughout the world's oil fields.

You'll find these field-proven parts specially packaged to insure factory-checked quality when you install them. Their long service life is especially important in areas where operations are far away from normal supply lines. Order National Fluid End Parts from the National representative in your area.

"Blue Stripe" Piston Rod with API Taper

API Dual Seal Piston

Type "G-I" Valve and Seat

"Nationaloy" Cylinder Liner

Valve Cap and Cylinder Head Packing

Cylinder Liner Packing

Gaskets and Packing — Selected for resiliency and resistance to the effects of chemicals or temperatures.

Liners — Hard, precision-finished working surface for long life, plus carefully-controlled outer dimensions insuring proper fit in pump cylinders.

Rods — Metallurgical control insures maximum resistance to abrasion, corrosion and wear.

Pistons — are made of a tough, resilient rubber, molded on a solid metal core to create a positive seal. The replaceable cup-type "Dual Seal" piston with API tapers is the latest addition to this National family. Replaceable cups on opposite ends of the "Dual Seal" insure a positive seal.

Valves and Seats — Maximum opening for fluid flow assures complete filling at high speed.

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NATIONAL BLUE OIL FIELD MACHINERY AND EQUIPMENT
SPANG STEEL PIPE AND ELECTRICAL CONDUIT

# THE WEATHERFORD TECHNIQUE

## Timing is vital

### when running and cementing casing

Poor timing can mean a costly remedial job, loss of oil, or a possible blowout. From the moment the drill pipe is laid down until the cement sets in place behind the casing, timing is critical.

For example, mud should not be allowed to set, uncirculated, in the uncased hole too long. The longer the delay, the more pressure is required to overcome the inertia of the thickened mud column, and the greater the danger of upsetting the delicate balance between mud weight and formation pressures. Hence, the need to keep elapsed time at minimum, the need for speed when making up the cement head and prefitting the casing with properly spaced reversible scratchers and centralizers.

When running casing, too, timing is vital. It must not be run faster than the mud column can be displaced, (because of destructive hydraulic pressure surges), yet if it is run too slow, valuable rig time is wasted. Stopping casing movement can cause gelled mud, drill cuttings and sloughings to pack off against the pipe and stick it. To avoid these dangers, casing must be run in one smooth operation.

After scratcher and centralizer-equipped casing is run, it must be reciprocated long enough to remove all excess hole growth, and until gelled mud and cuttings are circulated out. In certain wells this can take up to several hours. Here again timing is vital.

The Weatherford Technique, using Weatherford equipment, is your best assurance of a well-timed casing operation and a better cement job. Call the man from Weatherford.

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OIL TOOL CO., INC.

GENERAL OFFICES: 5920 Navigation Blvd., Houston, Texas

# THE OASIS—

## *A gathering spot for NOMADS*

**Foreign visitors and guests** at the New York Chapter's November 5 meeting were (front row) C. M. Richardson of Creole Petroleum, Venezuela; D. Desei of Shell, Venezuela; A. P. R. Church of Trinidad Oil Company, London, England; (back row) G. Cox of Creole Petroleum, Venezuela; H. Rex Collins of Hydril, member of the Los Angeles Chapter of Nomads; M. Garrison of International Drilling Company, Rome, Italy, and Ten Schad.

**International guests** and Los Angeles Nomads members heard Elmer E. Cuff, Public Defender of Los Angeles County, California, at the November 7 meeting. Shown here are visitors (standing) W. G. Middlestead of IPC from Iraq; E. L. H. Pierotti of Camdrill from Egypt; R. C. Smith of D & E from Iran; Buck Devine of P. y S. from Venezuela; Raymond Couderc of SYMAREP from Paris; G. H. Atkins of Basrah Petroleum Company from Iraq; George O'Neill of D & E from Brazil; (seated) Robey Deem of Empresa from Colombia; Pyrojna Chuenpratum from Thailand; speaker Cuff; O. Ledermann of Societe Languedocienne de Forages Petroliers from France, and George Emerick of Podco from the Philippines.

**Houston Chapter's** November 19 meeting brought these guests: R. L. Holden, retired, Houston; A. P. Berry, Socony Mobil, Houston; O. H. Arnold, Socony Mobil, Caracas, Venezuela; George Colton, Socony Mobil, Caracas; Mario Cueto, Reed Roller Bit, Buenos Aires, Argentina, and Bob Jarvis, SICA, Maracaibo, Venezuela. Sixty-five Nomads and guests attended this meeting.

**H. W. Haight,** president of Creole Petroleum Corporation, was honored by the Tulsa Chapter of Nomads at a reception and dinner on November 20. Almost 400 men turned out to hear Haight address the group on "Venezuelan Oils." Among the Nomads and guests present are J. F. Leonard, Ohio Oil Company; Haight; Don Collins, Republic Supply Company; W. J. McWilliams, Republic Supply, and F. C. Cummings, Axelson Manufacturing Company.

**Two newest Nomads** members of the Los Angeles Chapter are flanked here by Tom Martin of R. J. Eiche & Associates, Ritual Master, and Bill Brooks of Byron Jackson Tools, Sergeant at Arms. The new members, being given their certificates, are Lee Wardle of Globe Oil Tool, regular member, and Ray Faulk of H. C. Smith Oil Tool, associate member. Both were inducted at the November 7 meeting.

### Nomads Meeting Dates and Secretaries

New York Chapter, first Monday, of the month, Hotel Roosevelt, New York. Executive Secretary, E. W. Hoeppner, in care of Hughes Tool Co., Room 4414, 3 Rockefeller Plaza, New York 20, N. Y.

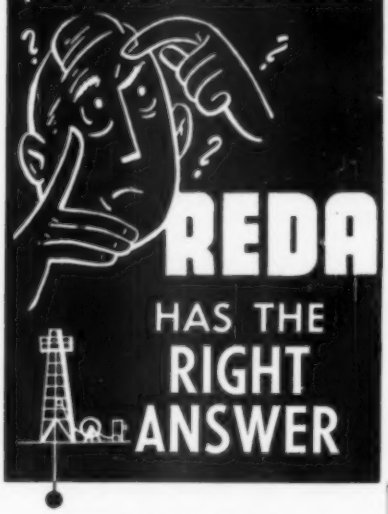
Houston Chapter, second Monday. Ye Olde College Inn, Houston, Texas. Executive Secretary, Harry E. Estes, P. O. Box 18161, Houston 23, Texas.

Los Angeles Chapter, second Wednesday, Jonathan Club, Los Angeles, California. Executive Secretary, W. A. Sawdon, P. O. Box 848, Hollywood 28, Calif.

Tulsa Chapter, third Friday, Mayo Hotel. Executive Secretary, E. L. Thomas, P. O. Box 4033, Tulsa, Okla.

Dallas-Fort Worth Chapter, first or second Monday. Secretary, H. A. Davis, H. A. Davis Power Equipment Company, 2142 Irving Boulevard, Dallas, Texas.

**HOW** to increase production? Lower Cost?



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Reda Pumps are used as original equipment, or replacement equipment, because they produce at a lower cost per barrel of fluid. Whether it's large volumes from shallow depths, or modest volumes from great depths, Reda Pumps provide operating savings.

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**IMPROVED EFFICIENCY:**

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If you have a pumping problem, our engineering staff is always ready to assist you. Phone or write:

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## National Board of Regents Discusses Venezuela Groups

Among the business discussed at the national board of regents of the Nomads in Chicago, Illinois, was the chartering of Nomads chapters at Maracaibo and Caracas, Venezuela.

The regents agreed that a sufficient number of qualified applicants should be contained in the petitions requesting charters. If 24 qualified applicants were included, the regents indicated that charters would be granted.

**Honored** by the New York Chapter at the November 5 meeting was T. G. Schad of the Asiatic Petroleum Corporation, who will soon retire. Schad is shown here (left) receiving a leather golf bag and golf course umbrella as a token of esteem from Chapter President H. Maland of R. J. Eiche & Associates.


**2 GREAT NAMES ARE JOINED!**

SEE PAGES A-18-A-19



**B and W SCRATCHERS AND CENTRALIZERS**

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B and W Latch-on Centralizer with Kon-Kave Bow
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# Mid-East Crisis Spurs Oil Search in Western Hemisphere

**Spot samplings of Caribbean, Central and South American oil activity reveals new concessions, surveying, accelerated drilling and exploration**

### VENEZUELA

★ Lion Oil Company Division of Monsanto Chemical Company, Tennessee Gas Transmission Company, Union Oil and Gas Corporation, Murphy Corporation and San Jacinto Petroleum Corporation, have joined in the acquisition of an oil and gas exploitation concession in Lake Maracaibo, Venezuela. The concession, which includes approximately 2000 acres, was one of those recently granted in that lake area by the Venezuelan government. Bidding had stirred considerable interest among oil firms as the producing areas in the lake north of these concessions for many years have accounted for the greater part of the Venezuelan oil. Bonuses paid by those acquiring concessions on 43,000 acres included in the Maracaibo letting yielded the government $79,000,000. All U. S. companies will participate through separate subsidiary companies. The same group also owns an exploration concession near the Colombian border in the Venezuelan state of Apure. Drilling of the first well on the Maracaibo concession will be delayed for several months because necessary equipment for deep-water drilling is not immediately available.

★ Phillips Petroleum Company has acquired the Venezuelan concessions of Pantepec Oil Company, Central America, subject to certain reserved rights, and has taken over operation of these concessions consisting of approximately 32,500 acres which currently produce over 5500 bbl of crude oil daily from about 150 wells. The properties are in the Mulata and El Roble fields of eastern Venezuela and are close to other Phillips production and to Phillips gas processing facilities. This enables Phillips to take immediate steps to increase production by opening up previously shut-in Pantepec wells. In addition, Phillips acquired Pantepec's one-half interest in a natural gasoline and crude stabilization plant in the Mulata field.

★ A mobile division from the General Geophysical Company has begun and its initial assignment will be a reconnaissance of oil and gas possibilities in virgin sectors of Venezuela for the Superior Oil Company. About 50 men will be used to turn up oil prospects in the South American country. Except for the seven Houston specialists, however, the others will be natives of Venezuela. Included in the first shipment to Venezuela were a recording truck, one shooting truck, two drill trucks, four water trucks (each of 700-gal capacity), one oil-field body truck and three wagon expresses.

### BRITISH HONDURAS

★ British Honduras Gulf Oil Company, a subsidiary of Gulf Oil Corporation, has announced that it will continue exploration activities in British Honduras desoite two recently drilled dry holes. British Honduras Gulf abandoned Hillbank No. 1 at 6550 ft on August 23, 1956, and earlier abandoned Yalbac No. 1 9005 ft. Santa Fe Drilling Company, contract drillers for both wells, has recently moved its rig out of the country. British Honduras Gulf will continue geological and photogeological work as well as reviewing data obtained from the two test wells. These additional studies are essential before further exploration drilling can be undertaken, company officials said.

### CUBA

★ Cuban Stanolind Oil Company has signed an agreement to spend an additional $4,750,000 in exploration and development work in Cuba. This supplements an earlier agreement committing the company to spend $10.000,000 during five years. New contract is between Cuban Stanolind, Trans-Cuba Oil Company, and Cuban Venezuelan Oil Voting Trust. These latter two companies agree to include all property they reserved in Oriente and Camaguey provinces in the original farmout agreement with Stanolind in September, 1955. In this case, two concessions were excepted in these areas, farming out these to Mountain Valley Oil Corporation. Among contract agreements made in the new arrangement is a stipulation called for Stanolind to begin drilling within 120 days and maintain one continuous drilling program for three years. Stanolind has also agreed to advance $1,000,000, without interest, to Trans-Cuba and CVOVT for drilling of development wells where oil may be discovered under the original or supplemental agreements.

★ The Cuban government signed a contract in Havana for the air mapping of the entire island. The survey will begin next month and will require two years to complete. It will cost $1,100,-000. Aero Service Corporation will make the survey. New maps will aid the development of Cuba's oil and mineral resources by defining boundaries of concession areas held by oil and mining companies and provide other essential data for planning and development. The survey covering approximately 45,000 square miles, will make Cuba the first country in the Western Hemisphere to have a complete, detailed map coverage for all its land.

★ Gulf Oil Corporation and Consolidated Cuban Petroleum Corporation have become partners in the development of a 25.000 acre tract in the Santa Clara Province, now owned by Gulf. Consolidated will undertake to drill an 8000 to 10,000 ft well in the area. Gulf has made extensive geological and geophysical studies and seismographic work in this area, as well as numerous core drillings there, prior to the delineation of a structure on which it finally selected the drilling location. The new contract, that gives Gulf and Consolidated each a half interest in the well, also entitles Consolidated to 50 per cent interest in 25.000 acres of land surrounding it. A supplemental agreement gives Consolidated an option for the drilling of a second well and the right to earn a 50 per cent interest in 12.500 additional acres of Gulf land in the Santa Clara province. Gulf's major holdings in Cuba are in the Santa Clara province and embrace over a million acres of land.

★ Consolidated Cuban Petroleum Corporation recently acquired 7000 acres of land in the Motembo field, located in the Las Villas province. Clarence W. Moore, company president, told a group of New York Security Analysts. The land contains 53 stringer wells producing pure naphtha. Consolidated is the only Cuban oil company that has oil production— producing about 40 per cent of all Cuban oil output.

# Oklahoma Contractors Review Association Action

Constructive work of the American Association of Oilwell Drilling Contractors in furthering the goals of the entire oil drilling and producing industry, as well as its own membership, was reviewed by a panel of four speakers at the December 5 meeting of the Central Oklahoma Chapter, in Oklahoma City.

Introduced by program chairman W. R. Ewert, Kerr-McGee Oil Industries, Inc., the speakers were Jack H. Abernathy, AAODC president; Joseph M. Shelton, insurance consultant; Brad Mills, AAODC executive vice president; and Paul Cain, president of The Cain Organization, Inc., public relations counselors.

Chapter Chairman Gerald N. Eason, Fain-Porter Drilling Company, presided over the meeting, attended by 185 AAODC members and oil producer guests.

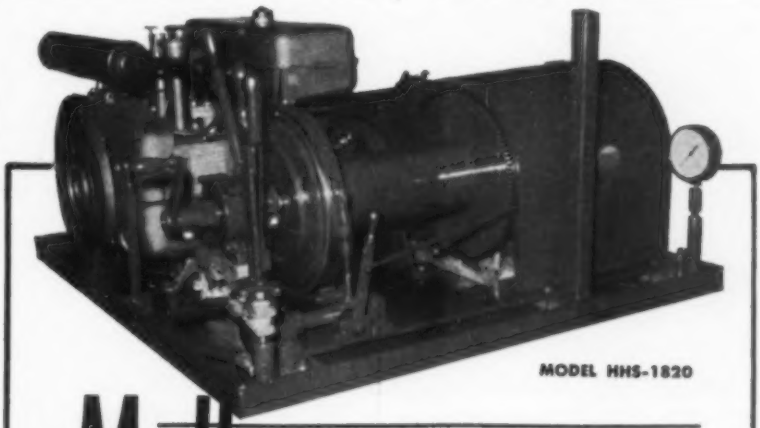
Abernathy devoted a major portion of his talk to the effect of oil imports on the drilling industry. Since the domestic producing industry drills about one well per $120,000 of crude oil sales, he said, "if you import $120,000 worth of oil it means in effect that you drill one less oil well in the U. S."

Pointing out that the AAODC is working closely with the President's Committee on Fuel Resources in an effort to balance imported and domestic production, Abernathy said that prior to the event of the Suez situation, "we were approaching an equitable agreement on the handling of the sensitive question. However, the trouble in the Middle East has thrown all this carefully planned work out the window. We will have to start again when the trouble quiets down."

Consultant Shelton called specific attention to the Insurance Committee's activity in delaying moves toward a shift of jurisdiction of workmen's compensation laws from state to federal bodies. Through numerous appearances before regulatory bodies, the Association has been effective in several areas in reducing compensation insurance rates for drilling contractors.

Shelton pointed out that total savings in Texas and Oklahoma through AAODC efforts to reduce workmen's compensation rates have been approximately $6,500,000 since 1952. "On a basis of 1000 rigs operating, these efforts reflect a savings over the period of $6500 per rig — certainly a highly significant saving."

Touching on AAODC activities and objectives, Mills said contractors now drill 93 per cent of all oil wells completed annually in the U. S., and oil companies look to the contractors for efficient performance. Contractors have improved the drilling rate of penetration by 90 per cent since 1941, Mills said, "The producers want us to share a portion of the responsibility in the production of oil. We are confident we are doing just that." ★ ★ ★

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# EXPLORATION ACTIVITIES

### CALIFORNIA

★ Richfield Oil Corporation is planning to test fringe potentialities along the 50-year-old Los Angeles city oil field in the Silver Lake district west of downtown Los Angeles. Richfield, who will drill the well horizontally from two one-acre sites, has indicated that oil prospects are good along the flank of the oil field, and probably deeper than the few remaining 1500 and 2000 ft Lower Pliocene and Upper Miocene sands. Before drilling can start, the area must be rezoned as an oil drilling district and surface drill sites approved by the city planning commission. Richfield's plans were a recent disclosure through active leasing play through the company's agent, Silverlake Royalties Company. The Los Angeles field is now almost completely abandoned except for a few old pumpers; it is very narrow but is about three miles long.

### NEVADA

★ Richfield Oil Corporation is currently drilling two wildcats, one at Bull Run Basin in Elko County, and the second in Paradise Valley, a few miles south of Las Vegas. The Bull Run Basin well was last reported drilling at 900 ft. The Paradise Valley well, the Joe W. Brown No. 1, was drilling at a depth of 4900 ft.

### CANADA

★ Canada Fortune Oil Ltd. is to drill another wildcat in the Chisholm Area of north central Alberta. This new test will be drilled by Bradley Oil Corporation, Ltd., and a group of United States interests represented by J. M. Young & Associates. This venture is about 95 miles north and northwest of Edmonton. It lies in an area where previous drilling has yielded oil and gas encouragement. Drilling rig is on the site, and hole will be taken down to test horizons including the Glauconitic sand and D-3 Devonian reef. This is the first in a series of projected tests scheduled.

★ Canada-Cities Service has another Cardium discovery in the Keystone area of Alberta Province. The Keystone area is approximately 12 miles east of the Pembina field and 50 miles southwest of Edmonton. Latest discovery is Alsike No. 16-29, completed for a flowing potential of 101 bbl of oil in 24 hours from Cardium perforations between 4049 and 4079 ft. The well is located on 1sd. 16, Sec. 20-49-4W5thN. Cities Service has approximately 14,000 acres in the Keystone area.

### PHILIPPINES

★ Active drilling operations are expected to get underway early this year in the Cagayan Valley of Luzon. Standard Vacuum Oil Company will be the operator. First well slated for drilling is to be located 18 miles northwest of Tunguegardo.

### NEW MEXICO

★ A Stanolind Oil & Gas Company wildcat in San Juan County has recovered 1000 ft of heavily oil and gas cut mud and 50 ft of free oil on drillstem test in the Paradox. The well, the No. 1 Hoover, tested at the interval 9790-9781 ft, with shut-in pressure of 2695 psi after one hour. The Paradox was topped at 9432. Stanolind is drilling ahead following the test. The well is located in Section 23-30n-16w, about 10 miles east of Shiprock. Stanolind has full interest in the well and an 8000-acre block surrounding it.

★ Tennessee Gas Transmission Company has an indicated wildcat discovery in its State A. A. Kemnitz "A" No. 1 in Lea County. Two drillstem tests have been made in the Permo-Penn lime, with results as follows: At 10,640-10,731 ft, the well flowed 13 bbl of oil and no water in 16 minutes on a 1-in. choke, and when pinched back to a ⅝-in. choke, flowed 157 bbl of oil and no water in two hours. At 10,737,-10,763 ft, it flowed 27 bbl of oil and no water in 20 minutes on a 1-in. choke, and when pinched back to a ½-in. choke, flowed 155 bbl of oil and no water in four hours. Drilling is continuing to projected depth of 11,500 ft. The company has staked a second well, the State A. A. Kemnitz "B" No. 1, one mile west of the indicated discovery.

★ A Pennsylvanian oil discovery for Lea County, was reported by Cities Service in the completion of the jointly-owned State AX No. 1 for a daily oil potential of 1022 bbl. The pool discovery is located on a 1280-acre unit owned by Gulf, Shell, Pure, and Superior, with Cities Service sharing slightly more than 50 per cent. The test was drilled to 12,341 ft in the Devonian and plugged back to 10,978 ft in the Pennslvanian. On a 13.5-hour potential test from perforations between 10,945 to 10,965 ft, it flowed 577 bbl of 41.6 deg oil and 247 bbl of water through 32/64-in. choke. Flowing tubing pressure was 560 psi and the gas-oil ratio 1651 to 1. Location of the test is SE NE, Sec. 14-18s-35e.

### OKLAHOMA

★ Union Oil Company of California has completed a wildcat, the McCormick-Union No. 1, flowing an estimated 10,000,000 cu ft of gas a day with a considerable ungaged amount of condensate through a 14/64-in. choke with 3000 psi flowing pressure. The well was completed at a depth of 8200 ft in the Morrow sand near McCormick, in Woodward County, about 35 miles southeast of nearest Morrow sand production in Harper County.

Union has an excellent land position surrounding the discovery, with an estimated 15,000 acres in the vicinity of the well and nearly 60,000 acres along the trend.

★ Red Fork gas production has been found in a Grant County wildcat drilled by Seneca Oil Company. The company's No. 1 Early, flowed 24,000,000 cu ft of gas per day from perforations at 4960-4974 ft. The Red Ford had a thickness of 52 ft, although the last 14 ft were perforated. Test was made on a 24/64-in. choke and the well had 1800 psi shut-in tubing pressure; final blow-down pressure was 1500 psi. Initial test ran eight hours. The Seneca discovery is south of the Eureka pool, with nearest producing well about 4½ miles northwest. The company is now testing its No. 1 Yerian, 2½ miles northwest of the Early well. The Yerian well was carried to the Mississippi chat.

### UTAH

★ Tidewater Oil Company is testing the Paria Domes structure of southern Utah, about 10 miles north of the Arizona border. The Paria Domes structure is 30 miles northwest of Arizona's Black Mesa Basin that embraces the northeast quarter of the state. Tidewater has scheduled the well to drill to 5000 ft or more.

★ A joint exploration program by Three States Natural Gas Company and Reynolds Mining Corporation has brought in 30-bbl per hour well in San Juan County, in the southeastern part of the state. The well is the Arrowhead No. 1, completed flowing 42 deg oil at the daily rate of 720 bbl on a 20-hour production test. The well extended the prolific Aneth pool westward about one mile. The Arrowhead No. 1 flowed through perforations at 5650-5716 ft through a 45/64-in. choke. Three States and Reynolds are currently engaged in drilling three other wells within three to five miles of the Arrowhead discovery. These wells are with Shell and Carter Oil companies.

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## Exploration

### TEXAS

★ Shamrock Oil and Gas Company has opened a new gas field in the Panhandle, eight miles northeast of Gruver townsite in Hansford County. Well was completed in the Mississippian below 7660 ft, with casing perforated in the Tonkawa sand at 5366-5376 ft. On completion test, the well made 900,000 cu ft per day on chokes.

★ Arkansas Fuel Oil Corporation has opened a new gas-condensate field off the Texas Coast at its No. 1 State Tract 905. The discovery is eight miles northeast of the Flour Bluff townsite in Nueces County. The well made 15,600,000 cu ft of gas per day and 17 bbl of condensate per million on chokes. Pipe was perforated at 7659-7674 ft. Total depth was 10,200 ft.

★ In Andrews County, completion of W. E. Bakke No. 3 V. L. Grady has opened Pennsylvanian and Wolfcamp production in the new Bakke Devonian and Ellenburger field, three miles southeast of Andrews. Flow of 276 bbl of oil per day was recorded from perforations in the Pennsylvanian at 9856-9886 ft, on ¼-in. choke, with no water accompanying flow. Wolfcamp oil came from 8514-8560 ft at the rate of 204 bbl of oil and one per cent water on a 1-in. choke.

### KANSAS

★ Cities Service is drilling the Cathcart No. 1 as a test well in the Southwest Warner block approximately 15 miles northwest of Oberlin. Cities Service has 1440 acres in the block. Located in the SE SW SE Sec. 17-1s-27w, Decatur County, the test is to be drilled to a total depth of 3620 ft and will test the Lansing, Pennsylvanian, Reagan, and Granite Wash formations. Nearest production is two miles to the north.

### LOUISIANA

★ Reports of discovery well drilled by Union Oil Company in partnership with the Louisiana Land and Exploration Company in Terrebonne Parish, have been confirmed as tests of a second sand zone with perforations of a 10-ft interval from 11,834 to 11,844 ft produced 35.2 deg crude oil at the rate of 325 bbl a day through a 10/64-in. choke with 2050 psi tubing pressure. The wildcat, Union LL&E State 2826-1 in West Timbalier Bay, was drilled to a total depth fo 15,010 ft. Only the first two of a series of thick saturated sands which were penetrated have been tested so far. An initial test of the interval from 11,938 to 11,948 ft showed production at the rate of 228 bbl a day of clean 34.9 deg crude oil through a 12/64-in. choke with 885 psi tubing pressure. A double allowable for the well will be applied for on the basis of a dual completion. Immediate development of the prospect is planned.

### ALASKA

★ Colorado Oil and Gas Corporation's first exploratory well on its Alaskan acreage will be commenced early next year. The company will be joined in this test by Frankfort Oil Company. The well will be located approximately three miles southwest of the ice-free port of Yakutat. The site is near the center of a block of some 1,100,000 acres in the Southeast Alaskan Panhandle, extending along the Gulf of Alaska from Icy Bay to Cape Fairweather. The area is approximately 1000 miles northwest of Seattle. Test is projected upon the encouraging results of the company's 1956 exploratory reconnaisance work in the Kakutat area. This work included five full months of geological mapping by seismic, gravity and surface crews. The well is intended primarily to gain knowledge of the sedimentary section to about 7500 feet.

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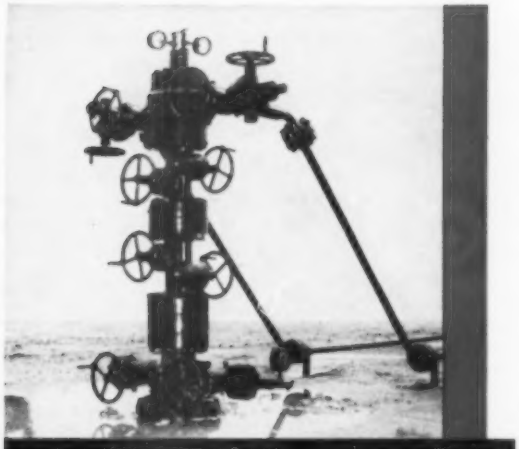

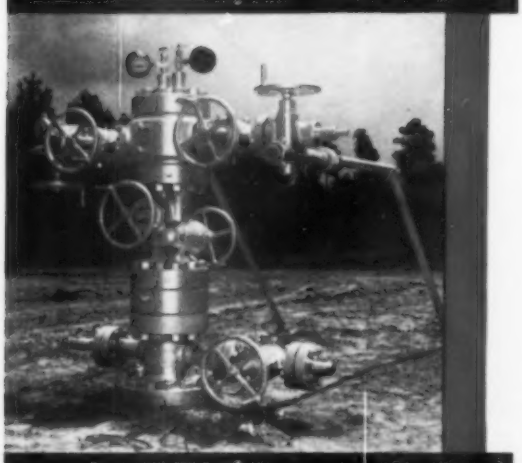

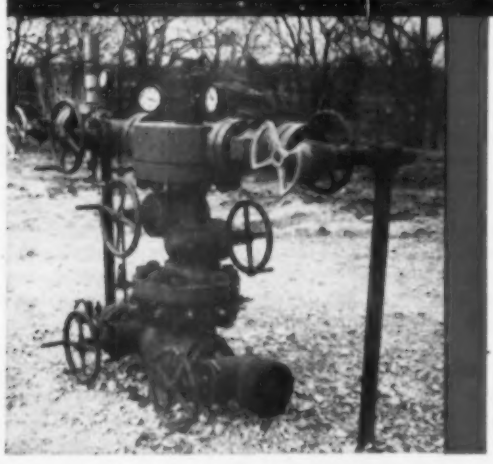

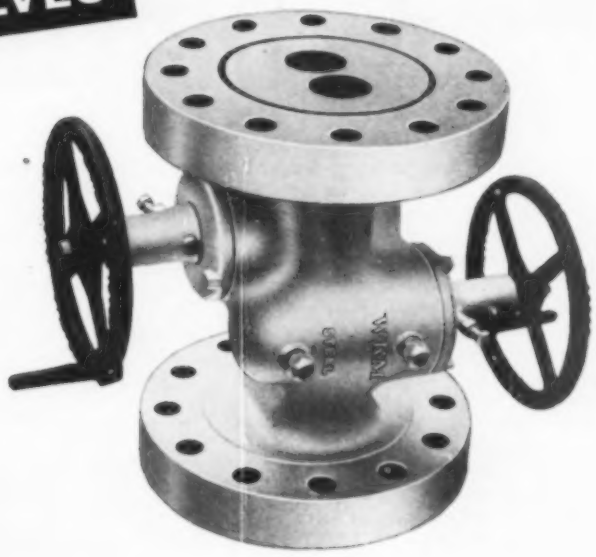

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B-139

# What's doing in DRILLING

★ **Shallow drilling in North Texas** is continuing strong in Knox and Baylor counties. The area is drawing 15 to 20 new locations per week, primarily for Tannehill tests. In mid-December, 11 new wildcat and 8 field locations were made in Knox County; Baylor staked 4 and 9 respectively. In one week, one operator — A. H. Bruner & Company, Dallas, Texas — filed for 8 new wells in Knox and 6 in Baylor. Depths of the Baylor tests range from 1600 to 1800 ft deep in the west central part of the county. Knox tests are mostly north and west of Munday and west and northwest of Vera ranging from 2000 to 2300 ft in depth.

★ **Drilling for natural gas** in North Texas is expected to be accelerated in coming months, especially in Wise, Parker, Jack and Montague counties. FPC recently approved for construction a new gas line into the Wise County area designed to ultimately take 240,000,000 cu ft of gas a day from this region and southwestern Oklahoma for ultimate delivery in the Chicago, Illinois area. One independent operator, Christie, Mitchell & Mitchell of Houston, has over 100 shut-in gas wells ready for the line and has "interest" in 10 rigs currently running. Several other operators with holdings in the area but currently inactive, have indicated new operations would resume on word that pipe for the new gas outlet would be on the ground by April.

★ **Drilling management practices** are being cussed and discussed in Houston, Texas, January 9-11, at the fifth Conference for Drilling Executives. The sessions, sponsored by the American Association of Oilwell Drilling Contractors, and are being held in Oberholtzer Hall on the campus of the University of Houston. In discussions led by M. L. Powers and E. H. Sloyer, the contractors are exchanging views on realistic bidding practices, personnel management, communications, and customer relations.

★ **Drilling in Israel** has been stepped up, according to officials of oil companies operating in the troubled little country. Acceleration of activity is taking place in spite of withdrawal of many American oilmen — who were advised to leave the country. The two principal companies own five drilling rigs, have leased others and are contemplating additional equipment to have 10 rigs working soon in the Heletz field, at Brur, and a wildcat operation in progress in the Dead Sea region.

★ **Gulf Coast offshore activity** is still gathering steam as a result of breaking the "no drilling ban" a few months ago. Names of new barges are fast being added to the oil industry's offshore drilling fleet, with some 107 rigs now operating in Texas and Louisiana tidelands. In one week in November, one Orange, Texas, shipyard delivered a 180-ft drilling barge, a 180-ft drilling tender barge, and one 54 by 100 ft drilling platform. One of these new units is Brewster-Bartle Drilling Company's "Timbalier Bay." This barge and seven others for this company have been built by Levingston. The drilling platform was constructed for Magnolia Petroleum Company for Gulf operations in about 20 ft of water. The drilling tender barge is headed for Lake Maracaibo, Venezuela.

★ **South of the Border,** Petroleos Mexicanos has indicated that the government-owned oil company is planning a highly stepped program of drilling beginning in 1957. According to a recent Pemex announcement, 27 new fields have been uncovered in the last three years, drilling 450 field and wildcat wells in 1956.

★ **Down State Drilling Company** has been organized and is operating out of Evansville, Indiana. M. W. Howard is president, Lyman J. Tanner of Marion, Illinois, is secretary-treasurer, and A. O. Burrell, of Marion, is co-owner and toolpusher.

★ **Oil Man of the Year** of Great Bend, Kansas, is Fred E. (Sam) Stickle, vice president and drilling superintendent of Stickle Drilling Company and also of Fesco, Inc., another drilling firm. Award was made to Stickle at the recent Black Gold Ball at the Great Bend Petroleum Club. He is president of the Kansas Independent Oil & Gas Association.

★ **Immediate drilling** of 20 key pilot water injection wells is slated by Big Chief Drilling Company and W. W. Whiteman, Jr. on 4400 acres of productive acreage in Allen and Neosho counties, southeastern Kansas. The Oklahoma City pair recently purchased the property from Joe Aylward, Wichita, Kansas, and Gordon Willis, Chanute, Kansas. The property purchased includes 300 oil and water-injection wells currently producing only about 500 bbl of oil per day. A portion of the leases are now waterflooded. Production is from the Bartlesville sand at about 800 ft.

★ **"The Miss Ethel"** has been completed in New Orleans, Louisiana, yards for Richardson & Stewart Company. This inshore barge measures 195 by 45 by 14 ft and is capable of 16,000 ft drilling in 14 ft water. Construction was done in the American Marine No. 2 yard.

★ **"Mr. Gus,"** G. C. Glasscock Drilling Company's well known offshore rig, is making Atlantic Refining Company's fifth try for offshore production. Mr. Gus was last reported drilling ahead in the Matagorda Island area, 20 miles east of land's end at Port Aransas, Texas. The test is being drilled in 80 ft of water, and is the third by Mr. Gus for Atlantic. The offshore rig moved into position early in November in Block 717 after drilling to about 8000 ft Atlantic's State Tract 527 S No. 1, dead and abandoned, about 90 miles up the Texas Coast from the present location.

★ **"Pacific Driller No. 1,"** Offshore Constructors, Inc.'s new $2,000,000 barge has been commissioned at Terminal Beach, California, as the first mobile drilling platform to operate anywhere along the Pacific Coast. The 200 by 100 by 13 ft DeLong structure, a type commonly used in the Gulf of Mexico, is at a site off Huntington Beach drilling on a lease held jointly by Monterey, Humble Oil & Refining, and Seaboard Oil companies. Operations on the platform have been subcontracted to Sun Marine Drilling Company, a San Joaquin Drilling Company affiliate.

★ **Program of offshore activity** on the West Coast was outlined at the commissioning of the Pacific Driller No. 1 by Monterey Oil Company President Howard C. Pyle. In establishing an orderly procedure for tidelands development, Pyle suggests that presence of structure be proved and limits of production outlined — "Then and only then would it be possible to plan an orderly development program without fumbling around."





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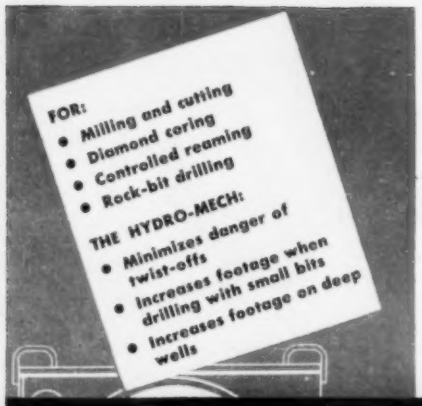


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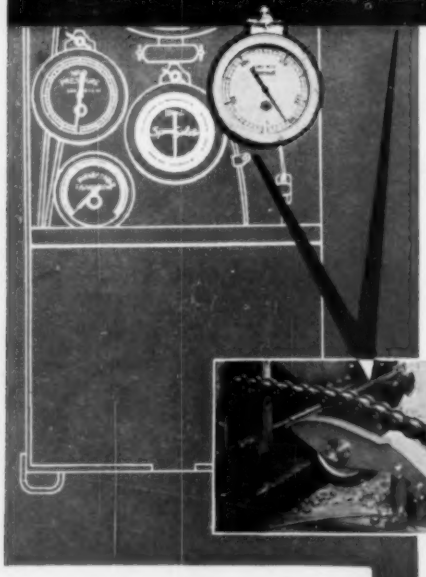

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## Rotary Rigs Operating in Oil Fields of United States and Canada*

| | Nov. 19 | Nov. 26 | Dec. 3 | Dec.10 |
|---|---|---|---|---|
| Alabama | 9 | 9 | 10 | 9 |
| Arkansas | 16 | 17 | 18 | 21 |
| Arizona | 0 | 0 | 0 | 0 |
| California | 114 | 111 | 114 | 111 |
| Colorado | 57 | 59 | 60 | 66 |
| Florida | 2 | 1 | 2 | 2 |
| Illinois | 0 | 0 | 53 | 0 |
| Georgia | 66 | 58 | 0 | 67 |
| Indiana | 10 | 10 | 10 | 15 |
| Iowa | 1 | 1 | 1 | 1 |
| Kansas | 169 | 179 | 180 | 187 |
| Kentucky | 11 | 11 | 12 | 11 |
| North Louisiana | 69 | 66 | 69 | 61 |
| South Louiciana — Land | 419 | 412 | 314 | 326 |
| South Louisiana — Offshore | | | 95 | 97 |
| Total Louisiana | 488 | 478 | 478 | 484 |
| Maryland | 0 | 0 | 0 | 0 |
| Michigan | 17 | 15 | 15 | 16 |
| Missouri | 1 | 1 | 1 | 1 |
| Montana | 35 | 39 | 37 | 34 |
| Mississippi | 25 | 29 | 29 | 28 |
| Nebraska | 28 | 27 | 26 | 28 |
| Nevada | 2 | 2 | 2 | 2 |
| New Mexico | 119 | 125 | 127 | 142 |
| New York | 0 | 0 | 0 | 0 |
| North Carolina | 0 | 0 | 0 | 0 |
| North Dakota | 28 | 29 | 29 | 29 |
| Ohio | 0 | 0 | 0 | 0 |
| Oklahoma | 258 | 262 | 281 | 280 |
| Oregon | 0 | 0 | 0 | 0 |
| Pennsylvania | 6 | 7 | 8 | 6 |
| South Dakota | 0 | 1 | 2 | 3 |
| Tennessee | 0 | 0 | 0 | 0 |
| Texas Gulf Coast — Land | 249 | 260 | 255 | 270 |
| Texas Gulf Coast — Offshore | | | 9 | 10 |
| West Texas | 381 | 377 | 386 | 380 |
| No.th Texas | 332 | 343 | 359 | 388 |
| East Texas | 66 | 66 | 78 | 75 |
| Total Texas | 1028 | 1046 | 1087 | 1123 |
| Utah | 28 | 27 | 26 | 29 |
| Washington | 1 | 1 | 1 | 1 |
| West Virginia | 3 | 1 | 2 | 3 |
| Wyoming | 60 | 61 | 63 | 67 |
| United States | 2582 | 2607 | 2674 | 2766 |
| Western Canada | 244 | 250 | 231 | 241 |
| Grand Total | 2826 | 2857 | 2905 | 3007 |

*As reported to the American Association of Oilwell Drilling Contractors by Hughes Tool Company.

## AAODC Organizes New Orleans Chapter

Seventeenth regional chapter of the American Association of Oilwell Drilling Contractors has been organized in New Orleans, Louisiana, with Earl G. Bateman, Bateman Drilling Company, as chairman.

Other officers named at the organizational meeting December 8 were Charles A. Norton, Norton Drilling Company, vice chairman, and Charles F. Hayes, Rimrock Tidelands, Inc., secretary-treasurer.

Brad Mills, AAODC executive vice president, said the New Orleans Regional Chapter will include the area south of Baton Rouge and east of Morgan City in Louisiana, and southern Mississippi.

**Organization plans** for the New Orleans Regional Chapter of American Association of Oilwell Drilling Contractors are discussed by the new officers. Shown are Earl G. Bateman, chairman; Charles A. Norton, vice chairman; Brad Mills, AAODC executive vice president, Dallas; and Charles F. Hayes, chapter secretary-treasurer.

# DRILLING STRUCTURES
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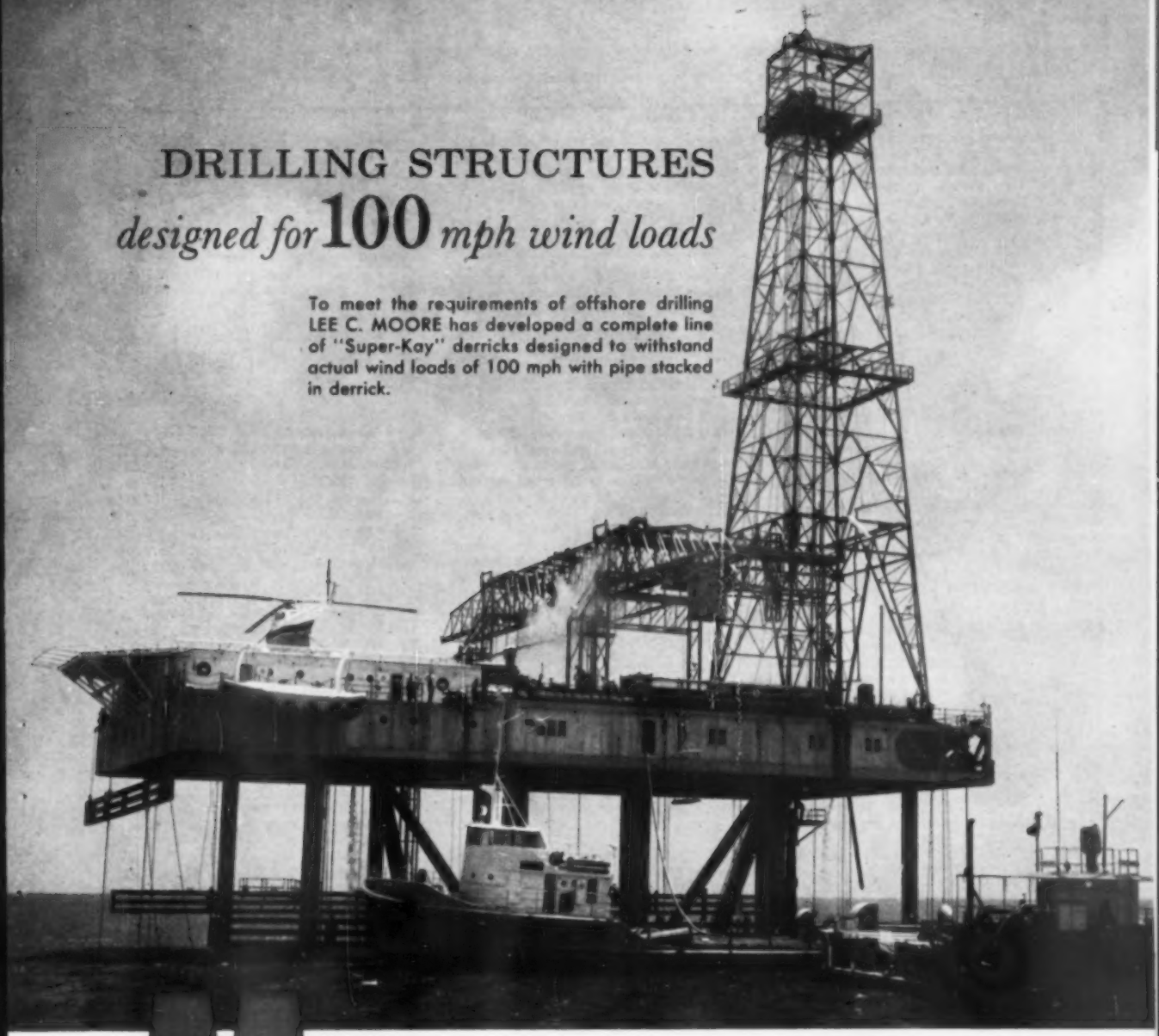

Four wells are drilled from this 140' **LEE C. MOORE SUPER-KAY** derrick by shifting the crown, rotary and racking platform.

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# RUNNING TOUR with MEN in the INDUSTRY

▸ The following changes have been announced by Magnolia Petroleum Company's geological department:

**W. R. Canada** has transferred from Houston, Texas, to Dallas, Texas, as staff geologist. **Kenneth F. Keller** named district geologist in Houston and **Wayne H. Mack** is district geologist in Shreveport, Louisiana. **Richard R. Church** has been placed in charge of Abilene, Texas, subdistrict. **G. Y. King** has transferred from Oklahoma City, Oklahoma, to Dallas on a temporary assignment to assist in regional development work.

A new district was formed from the Lake Charles, New Orleans and Morgan City, Louisiana, subdistricts with headquarters in New Orleans. **Robey H. Clark** is district geologist.

▸ **Ernest Fischer** has been named engineer at Hobbs, New Mexico, for district 1 of the New Mexico Oil Conservation Commission. He will supervise field work for the commission in Lea, Roosevelt, Curry and a portion of Chaves counties. He formerly was employed by Texas Railroad Commission and Gulf Oil Corporation.

E. V. Hewitt

▸ **Earl V. Hewitt** has been appointed division production superintendent for Stanolind Oil and Gas Company's North Texas-New Mexico division.

Formerly with Pan American Production Company in Houston, Texas, Hewitt has assumed his new duties in Fort Worth. He succeeds **Charles F. Bedford,** whose transfer to Tulsa, Oklahoma, and promotion to general superintendent of the producing department at Stanolind's general offices has been announced.

▸ The American Association of Oilwell Drilling Contractors has announced the naming of **E. Dale Mount,** Dallas, Texas, immediate past president of the association, as chairman of its national public relations committee. Also announced was the renaming of **William F. Clements Jr.,** Dallas, to the rotary drilling committee chairmanship.

▸ **Robert W. Stallings,** district foreman for Sinclair Oil and Gas Company's production department at Thrall, Kansas, has been transferred to Madill, Oklahoma. He succeeds **C. L. Cox,** who has been promoted to assistant district production superintendent and transferred to Nowata, Oklahoma. **Clyde C. Osborn,** assistant district foreman at Nowata, has been transferred to Thrall in a similar position.

▸ Sun Oil Company's Canadian production division, Calgary, Alberta, has announced the following appointments: **Frank Siegel** as division manager of exploration succeeding **Lloyd E. Miller,** who was promoted to assistant division manager; **Hilton Westmore** as division chief geologist, and **A. Douglas Brown** as division petroleum engineer.

▸ **George L. Coleman,** Miami, Oklahoma, has been elected a director of Zapata Petroleum Corporation, Midland, Texas. He is also president and director of the First National Bank of Miami and a director of Ben Hogan Company of Fort Worth, Texas.

▸ **Charles C. Conrad,** assistant foreman for the production department of Sinclair Oil and Gas Company at Odessa, Texas, has been transferred to Big Spring, Texas, in the same capacity.

▸ Frankfort Oil Company has announced the appointments of **Dolphe E. Simic** as exploration manager and **Thomas F. Brooks** as production manager.

Simic, a graduate geologist from the University of Nebraska, was vice president in charge of exploration for the Bay Petroleum Company. More recently he was associated with Halbert, Jennings & Simic, Oil Producers, Denver, Colorado.

Brooks was the general production superintendent for the Southern Production Company, Fort Worth, Texas, before joining the Frankfort organization. He is a graduate petroleum engineer from the University of Oklahoma, has also been associated with the Lion Oil Company.

▸ **Cecil V. Haven** has purchased 40 per cent interest of Toklan Oil Corporation of Tulsa, Oklahoma.

Also announced, **A. F. Childers, Jr.,** of Tulsa, formerly executive vice president of Toklan, has been elected president of the firm to fill the vacancy created by the resignation of **Roy B. Kelly** of Washington, D. C.

▸ **Melvin J. Hill** has been appointed director of the geology and geochemistry division of the Gulf Research & Development Company, research subsidiary of the Gulf Oil Corporation. Formerly division geologist for the Western Gulf Oil Company in Los Angeles, California, he will direct the activities of the division which is charged with the responsibility of developing new knowledge and new techniques in geology to aid the exploration geologist.

▸ **Arron M. Allen,** Magnolia Petroleum Company, Louisiana — Gulf producing district, has been promoted from assistant marine foreman, to marine foreman.

▸ **Maxwell L. Euwer** and **Elliott H. Powers** have been elected vice presidents of Union Oil and Gas Corporation of Louisiana.

Euwer joined Union Oil and Gas as chief petroleum engineer in 1938, then to assistant to the vice president, assistant vice president and vice president. He graduated from Colorado School of Mines with a degree in petroleum engineering.

Powers has been named vice president and manager of exploration. He is a graduate of Texas Technological College and has MS and PhD degrees in geology from the University of Iowa. He was with the Gulf Oil Corporation and in 1952 he was named vice president in charge of exploration for Southern Production Company in Fort Worth, Texas, and comes directly from that company to Union Oil and Gas.

▸ **Gerald B. Bennett** has been named acting division gas superintendent for Sun Oil Company's southwest division.

Also announced was the appointment of **Robert L. Sullivan,** formerly special assistant, as acting assistant division gas superintendent.

Bennett, who has been assistant since 1947, succeeds **Benton E. Warren,** who recently moved into Sun's foreign operations. He was with Sun Pipe Line Company briefly and then with Sun's Gulf Coast production division on a drilling crew, then as pumper, and for about nine years as a petroleum engineer. He moved to Dallas in 1947, as assistant manager; this title later was changed to assistant division gas superintendent.

Sullivan joined Sun in 1946 after brief practice as a lawyer, four years in the insurance field, and two years in the Army.

▸ **Henry H. Fuqua** has been appointed as Kansas district geologist and **Dwight S. "Bo" Ramsey** as Panhandle district geologist of the Vickers Petroleum Company, Inc. Both men will headquarter in the firm's new offices in Wichita, Kansas.

A graduate of Texas A&M, Fuqua was a subsurface geologist for Sinclair Oil and Gas Company and was engaged in geological activity for that company in Kansas for the past two years.

Ramsey is a graduate of the University of Arkansas. He was formerly associated with the Stanolind Oil and Gas Company.

▸ **J. F. Blackwell,** assistant manager (operations) of the producing division of The Texas Company's foreign operations department (Western Hemisphere and West Africa), has been transferred from Caracas, Venezuela, to the New York offices in the same capacity.

▸ **Leo C. Gravis** has joined Trunkline Gas Company of Houston as chief geologist.

The position has been created as part of Trunkline's program of expansion in the fields of exploration and gas supply. Gravis will direct Trunkline's exploration activities, to be carried out primarily in the Texas and Louisiana Gulf Coast areas.

Formerly, he was with Gulf Oil Corporation as manager of exploration for the offshore zone.

L. C. Gravis

Bryant Head

▸ **Bryant Head,** formerly employed by Monterey Oil Company, Midland, Texas, as district production superintendent, has resigned to join W. E. Bakke Oil Company as production superintendent, including operations in West Texas, New Mexico, Kansas and Wyoming. He was associated with Navarro Oil Company as district superintendent in Southwest Texas.

He will be headquartered in the main field operations offices of W. E. Bakke.

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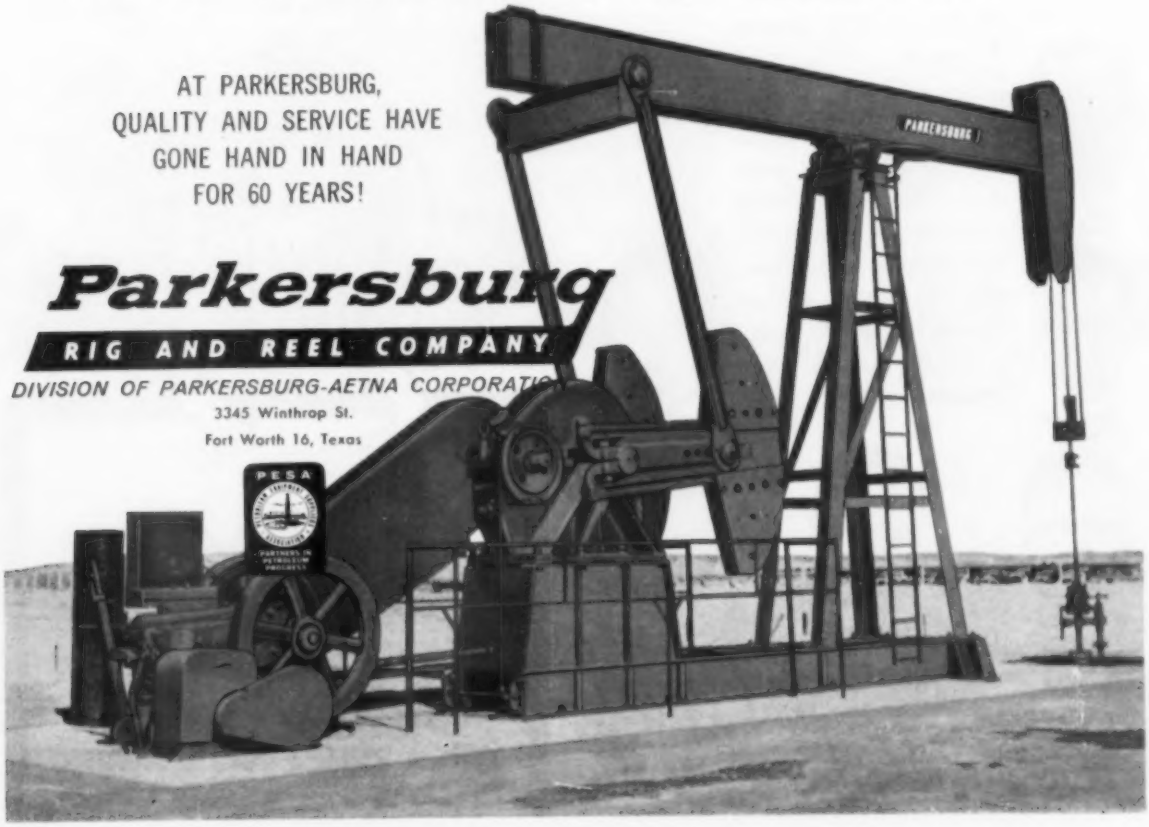

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# Kerr-McGee Begins $1,000,000 Building

Construction is scheduled to start this month on a $1,000,000 office building expansion for Kerr-McGee Oil Industries, Inc., Oklahoma City, Oklahoma.

The company's headquarters building will be enlarged from approximately 56,000 sq ft of floor space to 173,000 sq ft, in a project that calls for remodeling of two buildings and construction of an 11-story tower connecting them.

The present Kerr-McGee building is an eight-story structure on the northeast corner of NW Second and Robinson streets. Last spring the company purchased the old Oklahoma City YMCA building in the same block, and a two-story building intervening.

The two-story building will be torn down and the 11-story aluminum-and-glass tower built in its place. The two buildings thus joined will also be sheathed in aluminum, blending the structures into a single modernistic building.

A helicopter landing deck will be built on one section of the roof. The swimming pool and basketball court of the former YMCA building will be used as part of the Kerr-McGee employee recreation program.

Completion is scheduled for the end of 1957. Kerr-McGee offices at present fill the company headquarters building and are spread through the Republic and Council buildings nearby.


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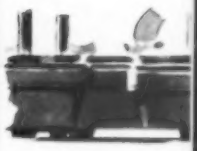

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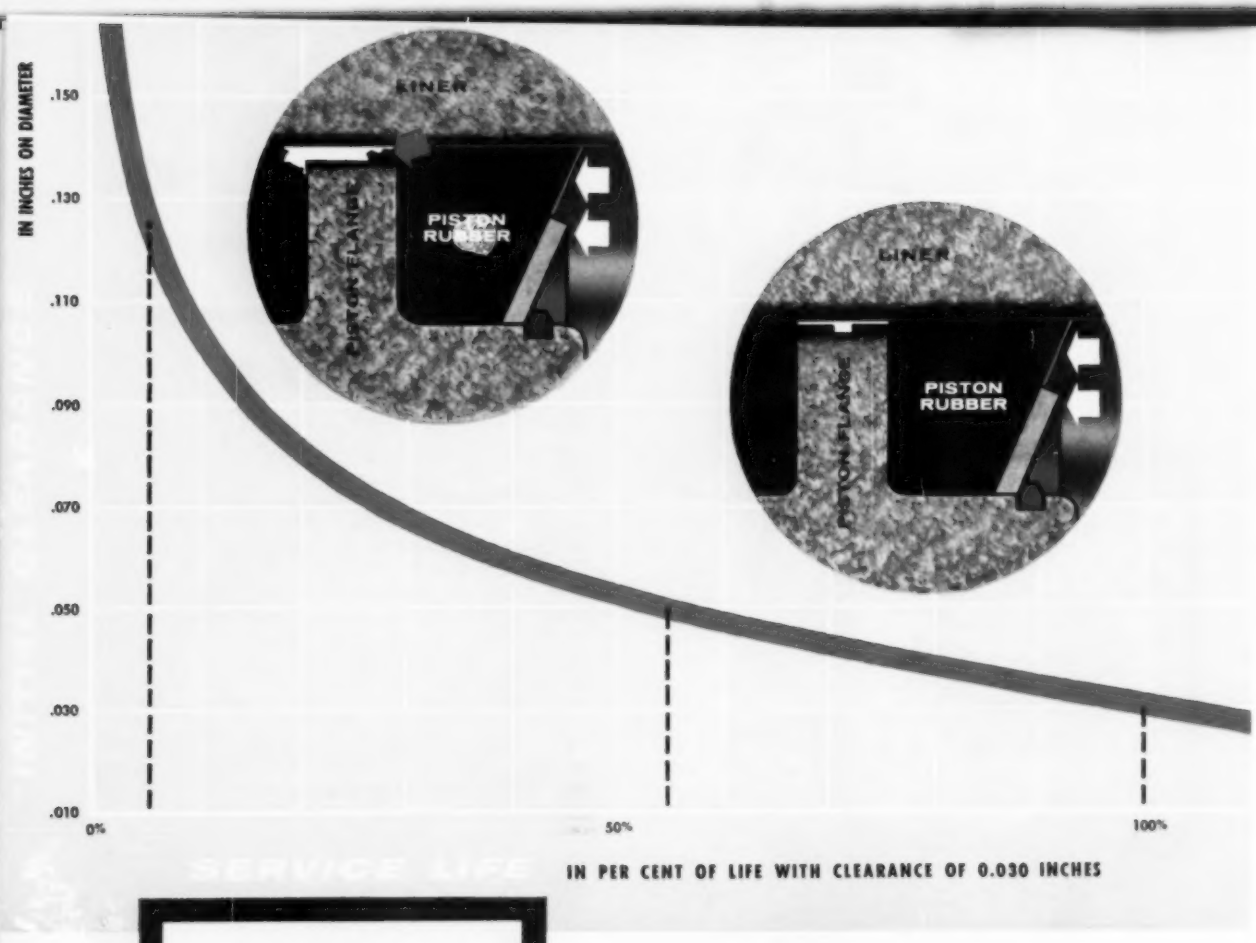


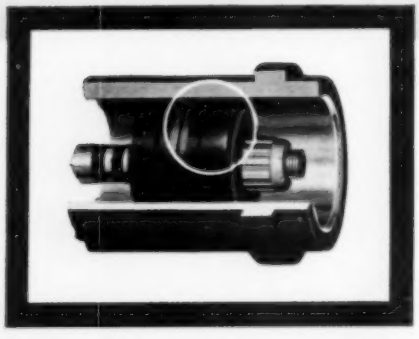

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## .... from piston rubbers when Piston-Liner clearance is kept low!

**THIS GRAPH IS AN ACTUAL RECORD** of a series of tests run in the Mission Test Pumps. It shows just how much piston rubber life can be increased by replacing both liners and piston bodies before they are excessively worn.

For example, it was proved that piston rubber life could be increased *ten times* when initial clearance was reduced from 0.125 to 0.050. This ratio applies for the test conditions. The general principle applies in many cases—especially when pressures are high and operating conditions severe.

There is one important thing the chart does not show, however. You get closer clearances—*longer*—when you use *both* Mission Pistons and Mission Liners. Precision machining, together with advanced metallurgy and heat treating, accounts for this longer life.

Save both money and down-time by replacing pistons and liners before they are worn too much. When you do, you will make a further saving if you specify *MISSION* Pistons and *MISSION* Liners. They are available through supply stores everywhere.

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# NEW Bucyrus-Erie 85-Ft. SERVICING DERRICK Simplifies Deep Workovers with 48-L

Here's an important addition to the long list of significant Bucyrus-Erie research developments in spudder design — an 85-ft. servicing derrick as special equipment for the 48-L spudder. Based on careful study of field needs, the new derrick provides added height without sacrifice of portability for fast, profitable clean-out, rod and tubing, or other servicing work. Its welded steel structure is similar to the 48-L's standard 60-ft. derrick which is unexcelled for strength and durability. Check the new derrick's outstanding features:

**AMPLE HEIGHT**
Plenty of lifting space to pull 30-ft. doubles.

**BIG CAPACITY**
Handles up to 60,000 pounds of tubing.

**STRONG STRUCTURAL DESIGN**
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**SIMPLE DESIGN**
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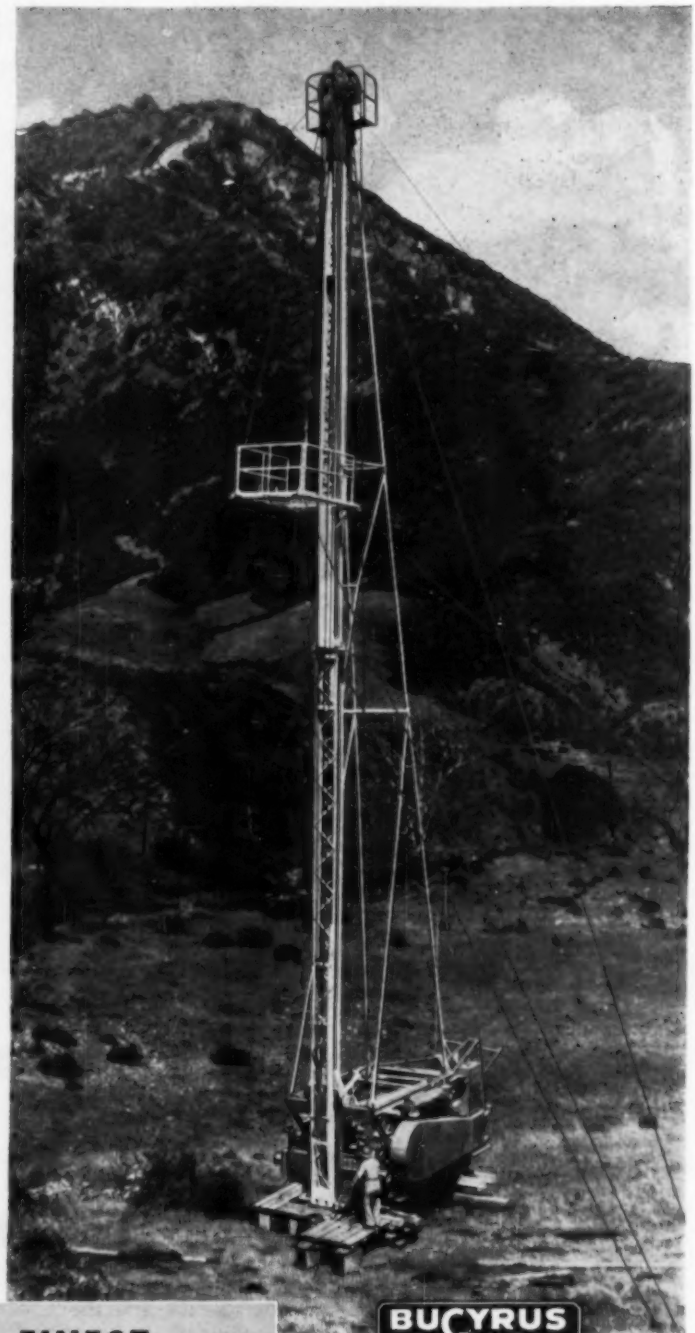

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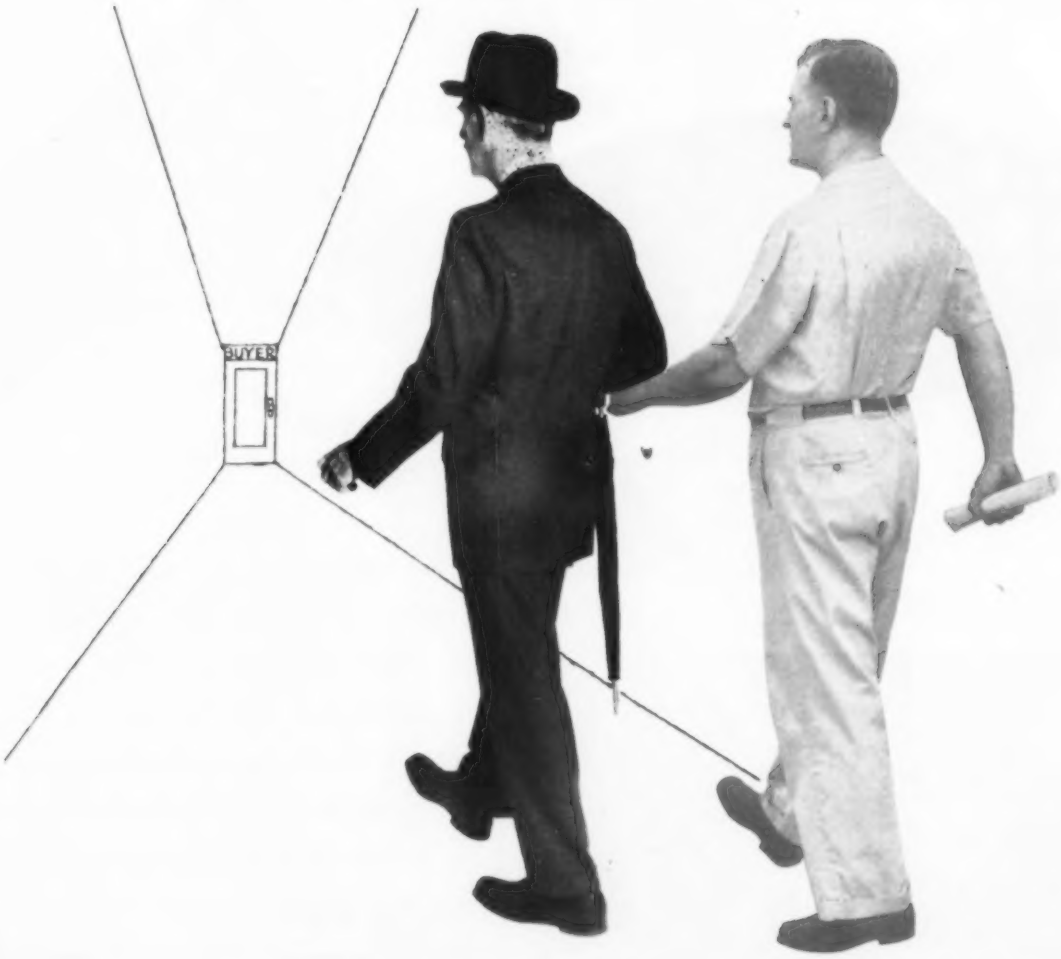


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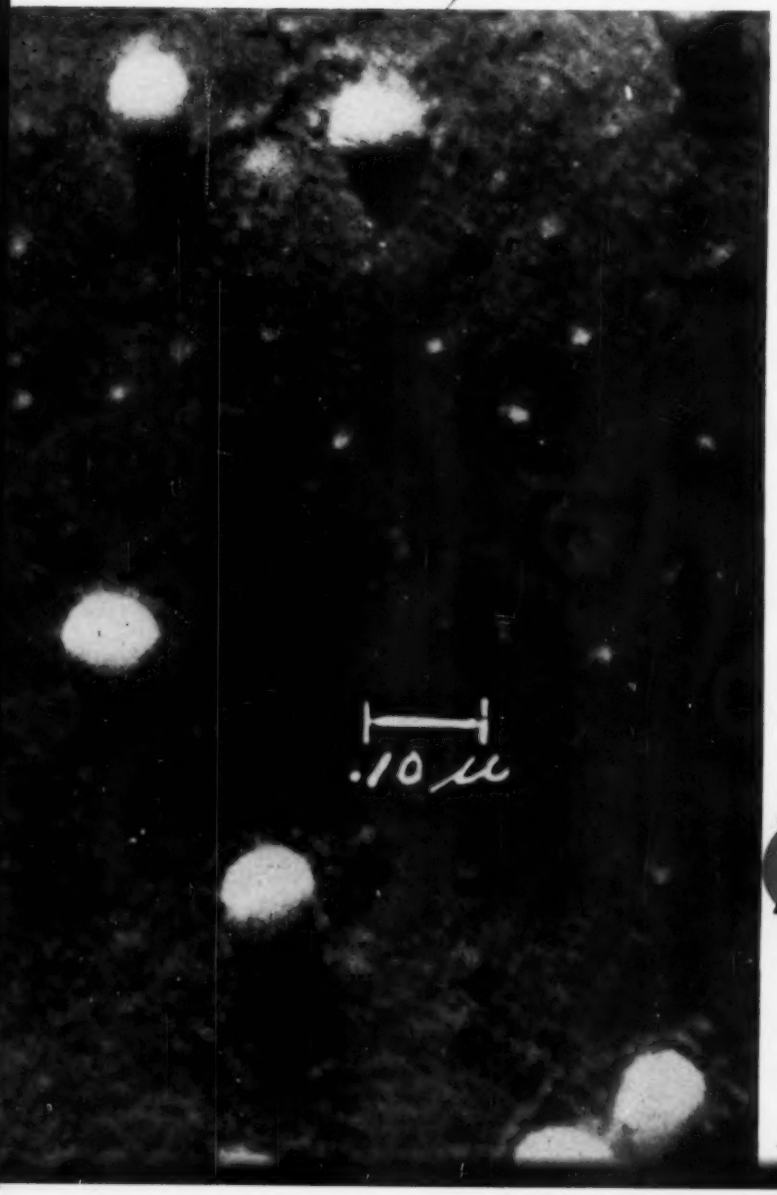


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1. Broad viscosity control
2. Low-cost control of fluid loss
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7. Versatile application in a variety of muds

If you are working with low-solids muds, you'll want to try this new HIGH viscosity CMC now. Ask your local mud dealer for it, or contact. . .

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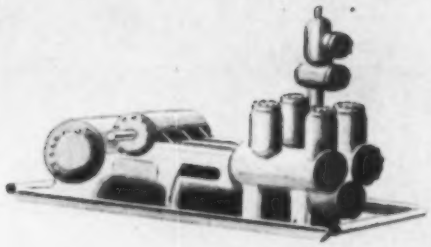

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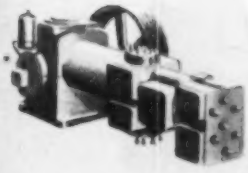

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# Why this pile of sand means lower drilling costs for a South Louisiana operator

The sand in this picture is part of nearly 1500 barrels that a Dorrco D-Sander removed from the mud in drilling one well in South Louisiana. Notice the sharpness of the cliff-like edges which show that the D-Sander not only removes coarse sand but also a great deal of silt and drilled clay solids.

As a result of this, pump parts last longer, bits drill faster and last longer, drilling time is reduced and the cost of mud chemicals is lower.

In one series of controlled comparisons a Dorrco D-Sander saved an average of more than 5,000 dollars per well. Because of savings like this, more and more contractors are installing Dorrco D-Sanders as standard equipment on all their rigs.

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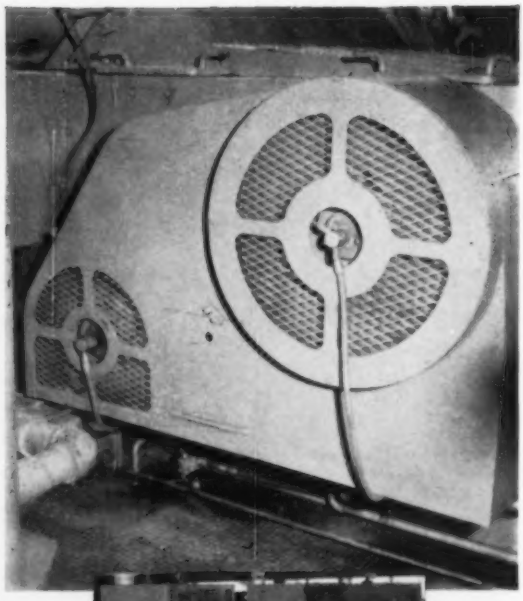
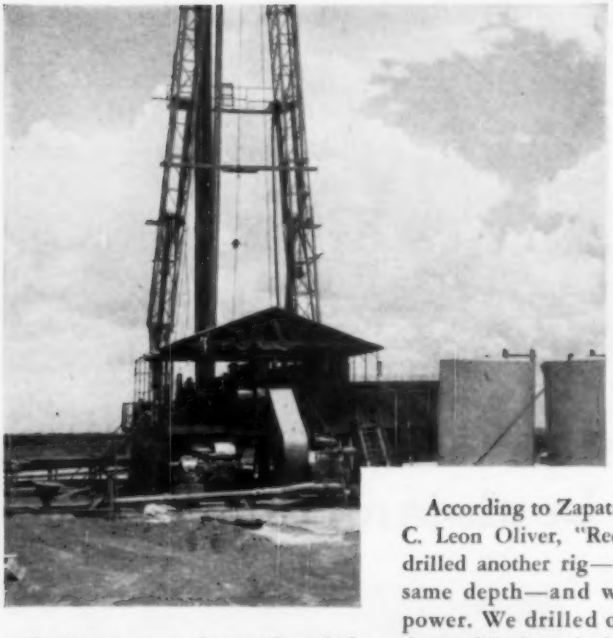
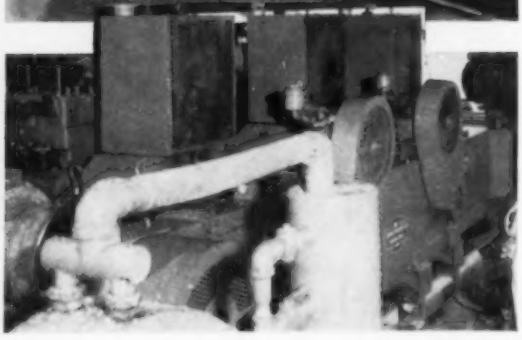
# Twin Disc-equipped rig drills 36,000 feet of hole in 6 months







During a recent six-month period, Zapata Drilling Company, working near Andrews, Texas, drilled six holes for an approximate total of 36,000 feet.

This impressive performance came from a Brewster N-75 drilling rig, powered by three 400-hp Waukesha Model LRORB gas engines—driving through *three* Twin Disc Model HUD Disconnecting Fluid Power Take-Offs. The drawworks is equipped with four Twin Disc Model PO Air Clutches—a Model PO-324 as the high drum clutch, a Model PO-330 as the low drum clutch, a Model PO-224 as the master clutch and a Model PO-218 as the rotary clutch.

According to Zapata's tool pusher, C. Leon Oliver, "Recently we outdrilled another rig—drilling at the same depth—and with the same power. We drilled our hole in 34 days, while it took the other rig 59 days. The difference was that the other rig was equipped with *mechanical* clutches.

"We were also able to cut our bit cost by *more than one-third* because of the smooth running of our rig through the Twin Disc Fluid Drives."

The Twin Disc HUDs dampen out starting shocks and sudden overloads . . . prevent engines from lugging and stalling and *reduce impact shocks up to 70% on both driving and driven equipment,* thus greatly lengthening the work life of the rig, while slashing maintenance costs.

Twin Disc Model PO Air Clutches provide higher torque capacity (up to 126,600 lbs. ft.) . . . more compact installation . . . faster, smoother operation under all conditions . . . positive, quick release—no seal drag—built-in pressure release valves.

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James O. Gravitt, R. R. 7
Robert Moore, Fairfield, Ill.

**HOUSTON 24, TEX.**
C. C. Pryor, 4002 Northfield Lane

**LOS ANGELES, CALIF.**
Lee Snodgrass Company, 8997 State St., South Gate, Calif.

**ODESSA, TEX.**
Specialty Sales & Service, Inc., 407 W. 2nd St.

**SALT LAKE CITY, UTAH**
Robert Taylor & Sons, 1077 S. Main St.

**TULSA, OKLA.**
Arduser and Company, P. O. Box 4267

**EDMONTON, ALBERTA, CAN.**
Osborn Engineering Sales Co., 10307 139th St.

**for this revolutionary new system of metering, testing, sampling and manifolding . . . Manually or Automatically Operated**

Designed specifically for the manual or automatic control of bulk liquid flow, the development of the Win-Well Valve now makes it possible to engineer radical changes in the economy of testing, metering, sampling and manifolding.

Win-Well's 9 ports can be adapted to connect as many as 7 input lines to a single output line, with an auxiliary output line. With the rotating element as the valve's only moving part, its Teflon bearing surfaces and seats mean high resistance to abrasion and corrosion in maximum high or low temperatures. Leakage, even under low pressure service, is non-existent due to Win-Well's unusually tight seals.

The Win-Well "system" for automation in oil production is equally applicable for electric, gas or pneumatic control, as field applications have shown.

Valve Service Rating — 300# WOG
Static tested — 900#

Patents Pending

There is a Win-Well representative serving all important oil areas in North America, ready to aid in your engineering problems.

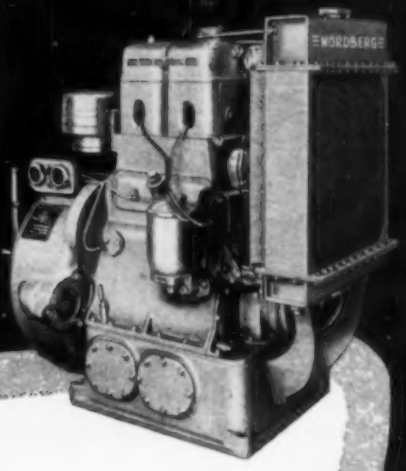
Win Well **Manufacturing Company**
8460 West Third St. Los Angeles 48, Calif.

# Complete Oil Field Sales and Service for

# NORDBERG

## POWER CHIEF®

# OIL FIELD ENGINES

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# FRED E. Cooper, Inc.

In keeping with plans to greatly increase the scope of service throughout the oil fields, Nordberg is pleased to announce the appointment of *Fred E. Cooper, Inc.* for the sales and service of Nordberg *Power Chief* Diesel and Gas Engines throughout all oil producing areas.

Backed by the well-known Cooper field service organization, and with parts stocks strategically located, Nordberg *Power Chief* Oil Field Engines will now, more than ever, be your best buy for production pumping and other oil field power jobs.

These heavy duty, medium speed engines are presently offered in 1 and 2-cylinder gas burning units up to 36 hp max., and in 1, 2 and 3-cylinder Diesel units from 10 to 45 hp.

For further details, contact your nearest Fred E. Cooper office, or write: *Nordberg Mfg. Co., Milwaukee, Wisconsin.*

**FRED E. COOPER, INC.**

**P. O. Box 1890, Tulsa 1, Okla.**
**Telephone 2-2194**

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DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

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*Builders of America's Largest Line of Heavy Duty Engines*

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# ALTEN
**PUMPING UNITS**

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# PUMPING their way to Leadership

Thousands of Alten units—operating for years with low, low cost records—are pumping their way to leadership. Put them to work for you!

A full line of 47 models and types including small beam balanced units, beam and crank balanced models, or medium and larger types with the Alten screw-type adjustable counter balance. You can be sure of peak performance with every model in each series.

Ask at your local supply store or write Alten for latest catalogue and engineering information.

**Worldwide Distribution Through Supply Stores**

**-ALTEN-**
**Foundry & Machine Works, Inc.**
LANCASTER, OHIO




FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

# NEW Drilling and Producing Equipment

**(1) Field Coil Insulating System.** An "integrated" field coil with a newly developed insulating system designed to protect electric motors and generators against atmospheric contaminants has been announced by Allis-Chalmers.

"Integrated" field coil construction is particularly well suited for applications requiring chemical resistance, oil and moisture-proofness, or sealing against atmospheric contaminants such as carbon black, dust, and dirt.

Primary insulation in the "integrated" field coil construction is glass with fibers tailored and oriented for maximum strength. Solventless types of inorganic, heat stable resins augment the glass fibers.

*Allis-Chalmers Manufacturing Company.*

**(2) Transporter.** A radically new type of vehicle for transporting freight over rough, open country, known as the "Oil-Field

Special," has been introduced by R. G. LeTourneau.

Their prime use is for movement of drilling rigs and other oil-field equipment and supplies through areas where truck roads are not available. Heavy haulers have load capacities of 35 tons. Unit shown is equipped with gin poles, gin pole raisers, rolling tail board, heavy-duty oil-field electric winch, and headache rack.

*R. G. LeTourneau, Inc.*

**(3) Miniature Floats for Vapor Control.** American Agile has announced an evaporator barrier specifically designed for vapor retardation by as much as 75 per cent.

Known as Agile Mini-Vaps, the barriers are in essence expanded polyethylene miniature floats containing thousands of tiny air cells for bouyancy and light weight. Surface contours of Mini-Vaps provide for extensive interlocking and clustering at the surface of volatile solutions.

*American Agile Corporation.*

**(4) Universal Tubing Head for Single and Multiple-Tubing Completions.** A Universal tubing head being manufactured by O-C-T permits a last-minute change to a single completion if a proposed dual completion fails to materialize.

Two retractable aligning screws orient dual hangers and are retracted when single-string hangers are used. All hangers may be landed and locked in place through blowout preventers, and this insures complete control of the well during completion operation.

*Oil Center Tool Company.*

**(5) Hydraulic Truck-Mounted Crane.** Truck-mounted crane, the Versa-Lift Model 400, has been placed in production. Crane mounts on any truck, from 1½ tons up, and will lift from 3500 to 7000 lb. Unit is completely hydraulic and powered by direct PTO-driven hydraulic pump.

*Teale & Company.*

**(6) Multiple-Stage Flash Distilling Plant Is Smaller.** Badger Manufacturing has announced the successful completion of tests of its new multiple-stage flash distilling plant. Unit is designed to produce distilled water from normal sea water.

*Badger Manufacturing Company.*

**(7) Shot-Hole. Drill** New rotary drill unit designated as Model M-8AL is equipped with a special long drill bar and mast.

Unit utilizes both compressed air and high-pressure water for drilling. Rated capacity is 6¼-in. holes up to 600 ft with air and 1500 ft with mud. It is said to effect substantial savings in drilling costs. It is recommended for shot and blast holes, structure testing, core drilling, etc.

*Davey Compressor Company.*

**(8) Line of Seismic Explosives.** Completion of line of seismic explosives is made available with Petron, a canned blasting agent specially designed for seismic prospecting.

A blasting agent rather than a high explosive due to its relative insensitivity, Petron can be detonated only by a suitable priming charge. Cans of Petron are designed for fast screw assembly into rigid columns.

It is available in 1-lb units of 2-in. and 2½-in. diam.

*Atlas Powder Company.*

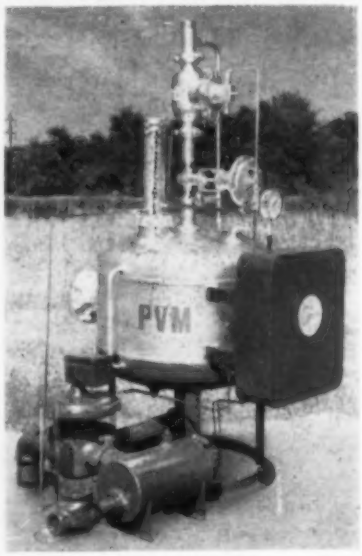
**(9) Teflon-Sealed Orifice Plate.** Daniel Orifice Fitting has developed an orifice plate sealing unit from Teflon.

Designed for use in Daniel Senior and Junior Fittings and Simplex Plate Holders, this seal unit is claimed to give perfect seal on both orifice plate and fitting seat.

The "TS" seal is a simple, two-piece unit that locks securely around the orifice plate with ring clips, and is recessed to receive Daniel Catalog 500 Orifice Plate. The plate can be removed by hand pressure alone.

*Daniel Orifice Fitting Company.*

**(11) Volume Meter.** A positive volume meter, designed to measure accurately the




flow of liquid from well, separator, treater, or tank, is offered by National Tank.

Known as the "PVM," the meter measures the positive volume between closed valves and is not dependent on accurate repetition of level controls, weirs, or rate of flow. Automatic sampler takes out a pencil-thin core of each cycle and saves it so that BS&W can be determined.

*National Tank Company.*

**(12) Above-Ground Water Storage.** New method for storing large quantities of water above the ground on oil and gas well locations for use in Riverfrac fracturing treatments has been developed by Dowell.

Sections of expanded metal about 8 ft long are bolted together to form a "circular fence" about 4 ft high. Then, expendable, polyethylene film is used to line the expanded metal to form a large above-ground tank.

Called Fraktanks, complete tanks can be assembled by two men and ready for filling in about 3 or 4 hr. Present limit to the size of the expanded metal Fraktank is 50,000 gal.

*Dowell Incorporated.*

**(10) Teflon-Sealed Tubing Joint.** A new concept in oil-field tubular goods connections is the GT-API Coupling.

While the first use for the GT-API Coupling Seal was for tubing, the seal can be used in all types of pipe connections. In recent tests, the seals of the 2⅜-in. and 2⅞-in. sizes withstood hydrostatic tests to 13,000 and 12,000 psi, respectively, and 100 cycles of thermal shock gas testing at temperatures to 180F and pressures to 10,000 psi.

Coupling seal is Teflon and because of its confining design, will withstand pressures encountered in modern production.

In addition, seals can be used to make old tubing and pipe hold pressure.

*Hardy-Griffin Engineering Corporation.*

**(13) Leakproof Plug Valve.** A plug valve that is said to provide absolute leakproof shut-off is now being manufactured by Circle Seal Products.

Design of the plug features the use of three "O" rings. In the closed position, one "O" ring contained on the surface of the plug (90 deg from the flow passage through the plug) serves as a flow seal. Static "0" rings at the top and bottom of the plug and around its circumference are claimed to prevent stem leakage.

Plug valve is made of brass and is available in ¼ in. female pipe connections.

*Circle Seal Products Company, Inc.*

**(14) Mobile Field Research Unit.** Geo-Lab is a mobile laboratory and living unit produced by Flintridge Motor Manufacturing. Unit is custom designed for use in field research.

Unit sits only 14 in. off the ground providing easy access and a low center of gravity, which enables it to cross rough steep-angle terrain with maximum safety. Added safety is achieved by front-wheel drive.

*Flintridge Motor Manufacturing Company.*

**(15) Integral Meter and Separator.** An oil meter and separator in one integral unit is being offered by Rolo Manufacturing.

The Rolocheck Metering Separator gives continuous information on the quantity of production while performing the regular separator functions.

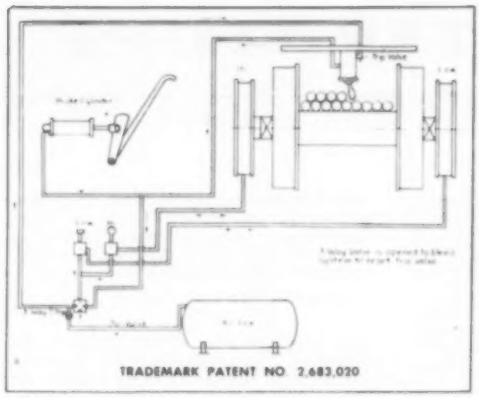
Separator is available in various sizes and pressures. Unit is available also as a three-phase unit with Rolocheck oil and water meters. Three-phase Metering Separators separate and meter the oil and the free water.

*Rolo Manufacturing Company.*

**(16) Retrievable Dual-String Packer.** Guiberson has introduced a new series of retrievable dual-string packers, Type RD with or without hydraulic anchor.

A jay-hook type stinger latch is furnished on packers with anchor and a plain stinger on packers less anchor. Available sizes are 5½ in. x 1¼ in. x 1¼ in., 5½ in. x 1½ in. x 1½ in., and 7 in. or 7⅝ in. x 2 in. x 2 in. EUE 8 round in a full range of casing weights.

*The Guiberson Corporation.*




**(17) Crown Block Protector.** A patented new device offers a simple solution to crown block protection. Called Crown-O-Matic Protector, it prevents costly accidents caused by running into the derrick crown and is adaptable to any rig.

Actuator mounted on the drawworks automatically shuts down operation when drilling line turns on the drawworks drum reach a predetermined number, the number necessary to bring pipe and hoisting apparatus to the danger point. (Above)

*Stewart & Stevenson Distributing Company.*

**(18) Computing Device Converts Signals.** A computing device that can be used in pneumatic measurement or control circuits for a variety of purposes is now being marketed by the industrial division of Minneapolis-Honeywell.

Called the Sorteberg Force Bridge, it is designed to convert a transmitted signal from a square root flow transmitter into a linear signal, permitting the use of a flow receiver with an evenly graduated chart. It can also be used to multiply, subtract, divide, or square pneumatic outputs, or to provide pressure and temperature compensation for transmitted flow signals.

*Minneapolis-Honeywell Regulator Company.*

**(19) Low-Cost Electro-Mechanical Control System.** Mechanical and pneumatic signals can be converted to direct current for long-range transmission and then reconverted to pneumatic pressure for actuating control valves or other pneumatic equipment.

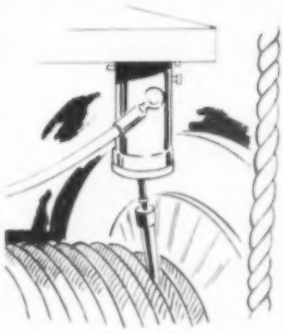
System—a development of Fielden Instrument Division of Robertshaw-Fulton Controls—permits extremely low-cost remote measurement, indication, recording, and controlling of process variables by the elimination of electronics and complex circuitry. Unit is called the "P-E-P transmission system."

*Fielden Instrument Division, Robertshaw-Fulton Controls Company.*

**(20) Fuel Tank-Engine Base.** A "wrap-around" base and fuel tank combination has been developed for use with Caterpillar Diesel Power Units and Electric Sets.

Bases have been designed for use with all Cat Engines and Electric sets from the D311 through the D342. These bases will replace the steel channel models formerly used. The streamlined, space-saving design will feature a greater fuel capacity, lighter weight and sturdier, more rigid construction.

*Caterpillar Tractor Co.*

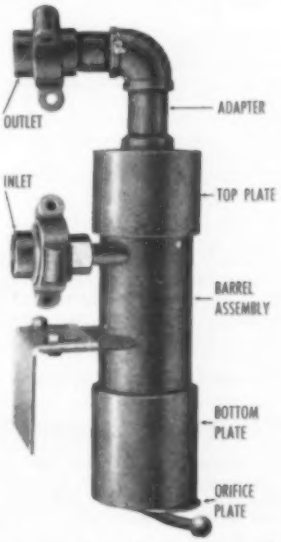


**(21) Bowen De-Sander** is designed for installation at the mud tank and functions to remove sand from the drilling mud after it has passed over the shaker. It restores the desirable, clean, non-abrasive properties of the drilling mud.

Means employed takes advantage of an inherent characteristic of sand — namely, its relative weight in comparison to the weight of the other mud constituents.

Bowen De-Sander is a small device, weighing approximately 115 pounds which can be easily carried to the installation point. Unit is designed to service one well using storage equipment and pumping equipment that are included in the normal complement of equipment on the rig.

Mud enters the de-sander in a manner that causes it to be rotated in a circular action around its walls. The centrifugal




force generated in this movement forces the heaviest weight particles against the outer walls. A combination of the heavier weight of the sand and the force of the pump pressure moves the sand toward the bottom. The lower portion of the de-sander is cone shaped and functions to increase the circular movement of the mud in this portion of the de-sander, thereby increasing the action of centrifugal force, causing only the very heaviest particles to concentrate at this end of the device where they are expelled through an orifice. Pump pressure then forces the lighter material out through the upper exit and back into the mud tank.

*S. R. Bowen Company.*

# NEW LITERATURE

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

**(22) Plastic Properties.** To help designers and fabricators choose the right plastic for any job, a revised 1957 edition of the "Condensed Reference File of Bakelite Plastics" has been published by Bakelite.

Distinguishing characteristics, appropriate fabricating techniques, and major fields of application are clearly defined for each different group of plastics in a terse, fact-packed style.

*Bakelite Company, a division of Union Carbide and Carbon Corporation.*

**(23) Inorganic Zinc Coating.** Amercoat's inorganic zinc coating for tank interiors and exteriors, towers, structural steel, piping, and offshore equipment is described in a new 4-page, illustrated brochure giving general, physical, and chemical properties of Dimetcote.

*Amercoat Corporation.*

**(31) Ball and Socket Self-Aligning Bushings.** Roller Bearing has issued a bulletin on its new ball and socket self-aligning bushings which are made out of SAE-52100 steel and through hardened to 60-63 Rockwell C scale and ground on all surfaces.

*Roller Bearing Company of America.*

**(25) Motor Selector.** A new 12-page Reliance Motor Selector, published by Reliance Electric and Engineering, gives full information on how to select a-c motors for specific applications. Two pages are devoted to a pictorial glossary of motor enclosure terminology.

*Reliance Electric and Engineering Company.*

**(76) Index of Instrumentation.** A new bulletin issued by Minneapolis-Honeywell is an index of industrial division literature. It covers catalog, bulletins, specification sheets, data sheets, illustrated lectures and articles from *Instrumentation Magazine.*

*Minneapolis-Honeywell Regulator Co.*

**(36) ~~T to 5-Hp Drippproof~~ and Enclosed Motors.** A 12-page publication illustrates production testing techniques and motor construction features. Color bulletin also describes servicing and installation advantages of the complete Tri Clad 55 line in these ratings.

*General Electric Company.*

**(28) Lubricated Plug Valves.** New 28-page catalog shows 100 per cent pipe area, venturi, round-port and diamond-port Homestead Lubricated Plug Valves in a variety of metals for 150 lb steam working pressure, 200 lb oil-water-gas, and A.S.A. 150 and 300-lb classes.

Complete with engineering dimensions, this catalog also shows different types of power operators for valves, in addition to complete lines of lever-operated and worm and gear-operated valves.

*Homestead Valve Manufacturing Company.*

**(29) General-Purpose Control Operation and Application Manual.** Thirty-two page, illustrated publication explains what each product is, shows how the product works, and tells where the devices can be applied.

*General Electric Company.*

**(30) Improved Line of Gas Engines.** An improved line of Model G-825 Superior gas engines, engineered especially for oil field application, has been developed by the White Diesel Engine Division of White Motor Company.

Bulletin 104 explains features of the 4-cycle, 6 and 8-cylinder engines, designed to operate at 900 rpm and from 200 to 630 bhp continuous.

*White Motor Company.*

**(24) Water Analysis.** Solvay Process Division, Allied Chemical & Dye, has announced a revised, enlarged edition of its technical and engineering service bulletin, "Water Analysis."

*Solvay Process Division, Allied Chemical & Dye Corporation.*

**(32) Production Metering and Testing.** Oil Metering and Processing Equipment has published a 12-page catalog covering its full line of metering and testing equipment products. Catalog is complete with specifications, operating procedures, and applications.

*Oil Metering and Processing Equipment Corporation.*

**(33) Survey.** Birdwell Micro-Profile Calipers and their uses in profiling oil and gas wells are presented in Bulletin B-2027 by Birdwell Surveys. Nine ways of using the improved three-arm caliper with three sets of controllable arms of different length are given.

*Birdwell Surveys.*

**(37) Oil Field Pump.** National F-15 triplex pump is presented in 4-page Bulletin No. 466. This 2-in. stroke pump is the smallest of four of this type ranging up to 5-in. stroke. Applications include waterflooding, salt water disposal, and other oil field services.

*The National Supply Company.*

**(35) Fittings.** A new 8-page bulletin, U-1-56, announced by W-S Fittings Division, H. K. Porter, presents complete dimensional and engineering data on the full line of W-S Forged Steel Unions for high-pressure service.

*H. K. Porter Company, Inc.*

**(27) Corrosion-Resistant Re-Rated Motors.** Bulletin features new Series 254-U All Weather rerated motors developed by Robbins & Meyers.

The elaborate 8-page bulletin describes the new motor's features, highlighted by a specially treated corrosion-resistant steel housing, which offers protection against all adverse weather conditions.

*Robbins & Meyers, Inc.*

**(34) Long-Wave Ultra-Violet Analysis.** Oil Base has completed a brochure on the establishment of a system to assure accuracy of long-wave ultra-violet analysis, to prevent misinterpretation of fluorescent "show" in cores and cuttings.

This important technical information is of extreme value as reference material to all persons having responsibility for drilling, testing, and logging.

*Oil Base, Inc.*

**(38) Improved Engine Generator Sets.** Bulletin 1083 describes the improved Model 40 stationary, portable and trailer-mounted engine-generator sets, designed to meet all NEMA and AIEE specifications. Dimension drawings, photographs, and charts explain the various generating sets.

*White Diesel Engine Division of White Motor Company.*

**(39) Use of Fluid Teflon.** Use of fluid Teflon as a thread-seal and anti-seize compound for metal, plastic, carbon, and ceramic systems and equipment is described in a new bulletin offered by Eco Engineering. Included are typical applications for fluid Teflon, designated as Eco T-film, in the chemical, petroleum, nuclear, photographic, and process equipment industries.

*Eco Engineering Company.*

**(40) Savings Through Standards.** Proof of the value of standardization in the field of machine tools is stressed in an extensive survey report, "Dollar Savings Standards," which highlights economic benefits to American industry resulting from the use of standards.

This 40-page survey is being made available by the American Standards Association as a service to American industry. The report is an up-to-date version of the original edition of 1951 and contains 79 documented case studies covering 27 industrial fields.

*American Standards Association.*

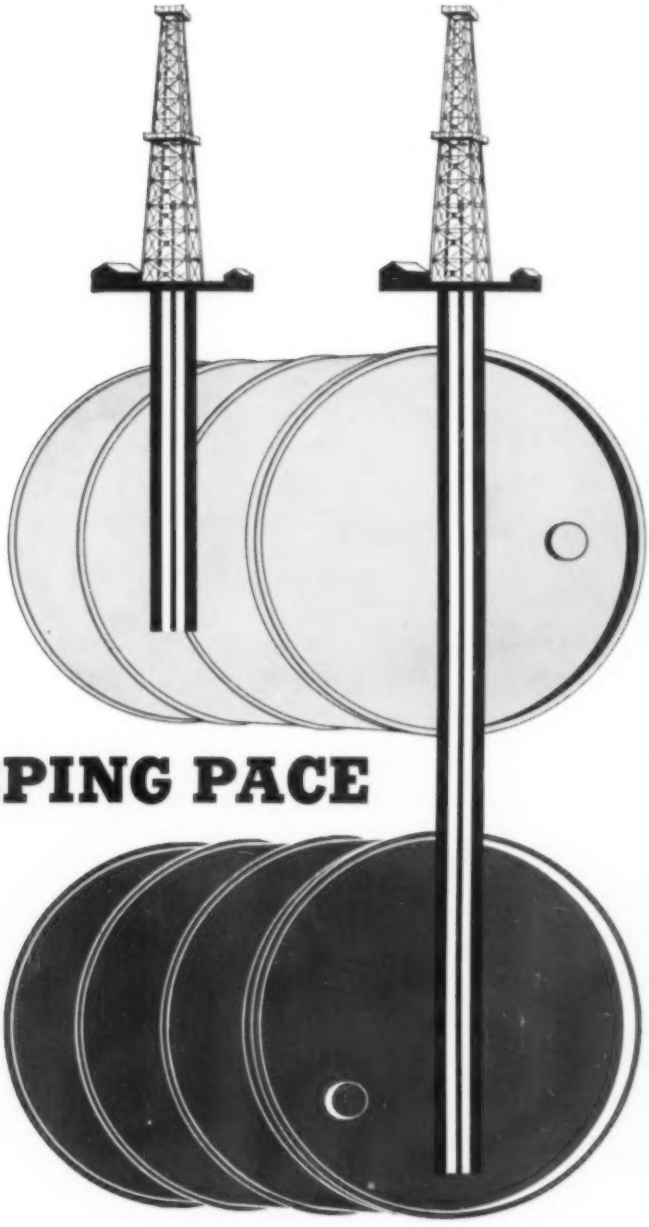
**(26) Corrosion Control With Tape.** A new, 8-page, illustrated booklet describes the advantages of Trantex Poly Vinyl Tape for covering and protecting pipes, valves, frames, racks, and metal surfaces against corrosion both above and below ground.

*Dutch Brand Division of Johns-Manville.*

**(77) Digital Computers in Automatic Processing.** Digital computer operation conforms to simple rules of symbolic logic, and most of its calculations are based upon a system of binary, rather than decimal, numbers.

New booklet is a primer on the subject of digital computation. To persons in many industries and trades, technical or non-technical, this booklet can help show the important rudiments upon which digital machine computation is based.

*The Computer Control Company.*



# KEEPING PACE

Drills were chewing their way down for about 2000 feet in the search for oil in 1916. Today's drilling depth is more than double that.

The change in drilling that forty years has brought well symbolizes many advances in the petroleum and chemical industries. Engineers have dug more deeply into the secrets of nature, too . . . have designed plants and processes to wrest new products and services from petroleum, ores and elements.

We mentioned 1916 because that is the year Sun Ship was founded. It has long served the swift-growing needs of petroleum and chemical industries. Year by year, the engineering skill and facilities of . . . reat Sun Ship plant have proven their ability to meet the demands for plant and equipment keyed to the swift pace of progress in these and other important fields. Sun Ship keeps pace with progress.

Sun

SHIPBUILDING & DRY DOCK COMPANY

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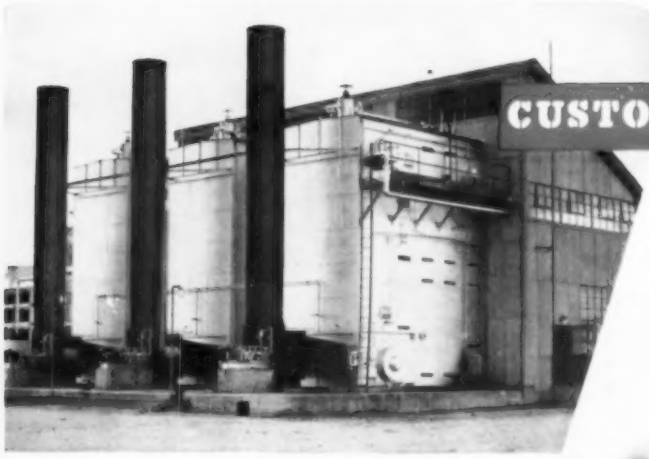
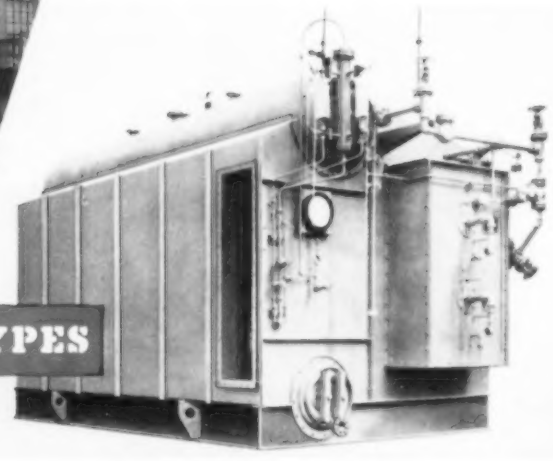
## Conoco Reveals Plans for



CUSTOM BUILT TYPES



PACKAGE UNIT TYPES

# Stop 'n Shop at Vogt

## for modern Steam Generators

### Types and Sizes for Every Power, Processing and Heating Requirement

Steam costs too high? Then it's high time to replace outmoded boilers with modern Vogt steam generators of the type and size to exactly fit in with specific operating conditions.

Vogt steam generators are designed to give maximum rating in minimum space, with high efficiency and low maintenance expense. They are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid or gaseous fuels burned singly or in combination.

Package units range from 10,000 to 30,000 pounds capacity and custom built units are obtainable in the larger capacities. Many installations in successful operation are proof of Vogt's ability to give effective help in the solution of steam generating problems. Bulletins may be had upon request.

*Address Dept. 24-BRE*

**HENRY VOGT MACHINE CO.**

**LOUISVILLE, KENTUCKY**

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

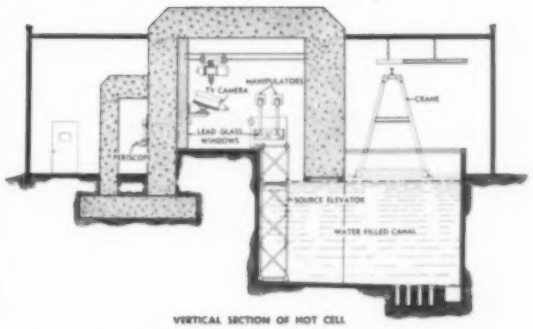
## Conoco Reveals Plans for

# Atomic Radiation Lab

Now being built at the Ponca City research center, a unique radiation source will be used

OVERHEAD VIEW OF HOT CELL

An overhead view of Continental Oil Company's atomic radiation research unit, showing the "hot cell," with its viewing windows and labyrinth entrance. Laboratories at the right will be used for radio-isotope research.




VERTICAL SECTION OF HOT CELL

The experiment room or "hot cell" in Conoco's atomic radiation laboratory. Uranium cylinders containing the fuel elements for the radiation studies will be stored in a water well and elevated to the hot cell by remote control. Cell wall will be special, 5½ ft thick concrete.

ADDING to the long list of oil companies having or building atomic radiation research facilities, Continental Oil Company is constructing a $500,000 radiation laboratory at its Ponca City, Oklahoma, research center. In addition to housing equipment for fundamental studies on radiation processing in petroleum refining and petrochemicals, the laboratories will be used for radio-isotope work now conducted at other facilities at Ponca City.

Atomic radiation research is not foreign to Continental; it has been supporting for the past two years exploratory work in this field at the University of Michigan. In addition to new projects, the results of this work will be further studied at Ponca City.

**A unique radiation source** will be employed, consisting of fuel elements in two-foot long uranium cylinders shipped from the AEC plant at Arco, Utah. The laboratory will be among the first to use this source of radiation.

The elements will be stored in the bottom of a 16-ft well beneath the small "hot-cell" in which the radiation work will be done. All handling will, of course, be done by remote control. In addition to lead-glass viewing windows and periscopes, operation will be observed with a closed-circuit television camera. The air will be changed in the cell area every two minutes; sodium vapor and high-powered flood lights will assure good visibility.

A special feature will be a low-level radiation room where a beam of gamma rays can be directed through oil well cores for studying water, gas, and oil content of the rocks. This room, adjacent to the hot cell room, can also be used to study other types of chemical reactions.

Continental will also house its radio-isotope study facilities in the new building. Formerly scattered around the large research center, work with radio-active piston rings and other studies involving "active" engine parts will be conducted here. Equipment used for studies of corrosion, reaction rates, and other chemical measurements also will be moved into the new lab.

Design of the atomic radiation laboratory was by Walter Kidde Nuclear Laboratories, Long Island, New York, and Walter Kidde Constructors, Inc., is doing the construction work. Completion is planned for March. ★ ★ ★

# ISO-

# ISOMERIZATION

- Isomerizes Pentane and Hexane Fractions
- New, Precious Metal Catalyst (non-platinum)
- Isomer Yields of 97% and Higher
- Flexibility of Feedstocks
- No Corrosive Elements in System
- Only One Reactor Needed
- Minimum Makeup Hydrogen Required

## ISOMERIZATION OF PENTANE-HEXANE FRACTION FROM COMMERCIAL STOCKS

| | KUWAIT | | MID-CONTINENT | | NAT. GASOLINE | |
|---|---|---|---|---|---|---|
| | Feed | Product | Feed | Product | Feed | Product |
| TOTAL $C_5$-$C_6$ | | | | | | |
| Vol. % | 100.0 | 97.3 | 100.0 | 96.7 | 100.0 | 99.2 |
| Octane CFRR-Clear | 63.7 | 77.7 | 62.1 | 77.0 | 72.3 | 83.3 |
| +3 cc TEL | 88.3 | 96.2 | 87.3 | 95.8 | 93.9 | 99.8 |
| PENTANE FRACTION | | | | | | |
| Vol. % | 45.0 | 45.0 | 34.5 | 34.5 | 58.5 | 58.5 |
| Octane CFRR-Clear | 74.4 | 91.0 | 72.9 | 91.0 | 79.2 | 91.0 |
| +3 cc TEL | 95.8 | 104.9 | 94.9 | 104.9 | 98.4 | 104.9 |
| HEXANE FRACTION | | | | | | |
| Vol. % | 55.0 | 52.3 | 65.5 | 62.2 | 41.5 | 40.7 |
| Octane CFRR-Clear | 54.9 | 66.3 | 56.4 | 69.2 | 62.6 | 72.2 |
| +3 cc TEL | 82.2 | 88.7 | 83.3 | 90.7 | 87.5 | 92.4 |



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

# KEL

# by M.W. KELLOGG

ISO-KEL is a new process developed by The M. W. Kellogg Company for isomerizing light naphthas. Designed to help refiners increase their high octane pool, ISO-KEL can upgrade combined streams of pentane and hexane fractions as well as natural gasoline.

One desirable application of ISO-KEL produces two separate products: (1) an isopentane stream of 104.9 CFRR+3 cc TEL, and (2) an isohexane stream of 89 to 92 CFRR+3 cc TEL, depending on the feedstock. When charging light naphtha, the combined streams have an over-all yield of 97 vol. % and an octane number of about 96 CFRR+3 cc TEL. When feeding natural gasoline, over-all yield is 99 vol. % and octane number about 99.8 CFRR+3 cc TEL.

The advantages of this new ISO-KEL process rest on a new, precious metal catalyst (not platinum) developed by M. W. Kellogg's research laboratories. This vapor-phase process requires only one reactor—which operates in the presence of hydrogen. Operating conditions are less severe than those for reforming heavy naphtha.

Economic soundness of the ISO-KEL process is illustrated in the case of a 50,000 BPD refinery, where a 3,100 BPD ISO-KEL unit would have a payout of about 19 months. Write for further economic and technical data.

Refinery Process Division

**THE M. W. KELLOGG COMPANY**

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Refinery Process Division
THE M. W. KELLOGG COMPANY
711 Third Avenue, New York 17, N. Y.
*Send further information on* ISO-KEL *Isomerization*

Name_____

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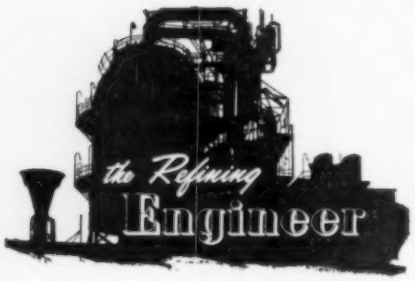
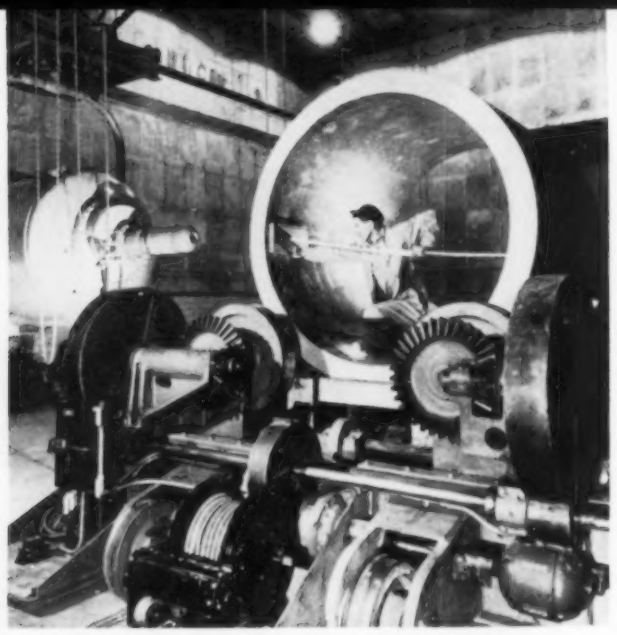
exclusive



A 5-in. thick shell base being readied for X-ray test before "stripping on" thin bands to attain the desired thickness in the finished shell.
— Courtesy Babcock & Wilcox Company

# SKY-HIGH PROCESS PRESSURES DEMAND MASSIVE VESSELS

**Raymond Meyer**
*Griscom-Russell Company*

WORKING pressures for heat exchangers are on the way up. It was not too long ago that pressures of 5000 psi were considered high. But now designers of heat exchangers must face the coming demand for shells to withstand pressures up to 100,000 psi. Are manufacturers prepared to supply shells for these astronomical pressures?

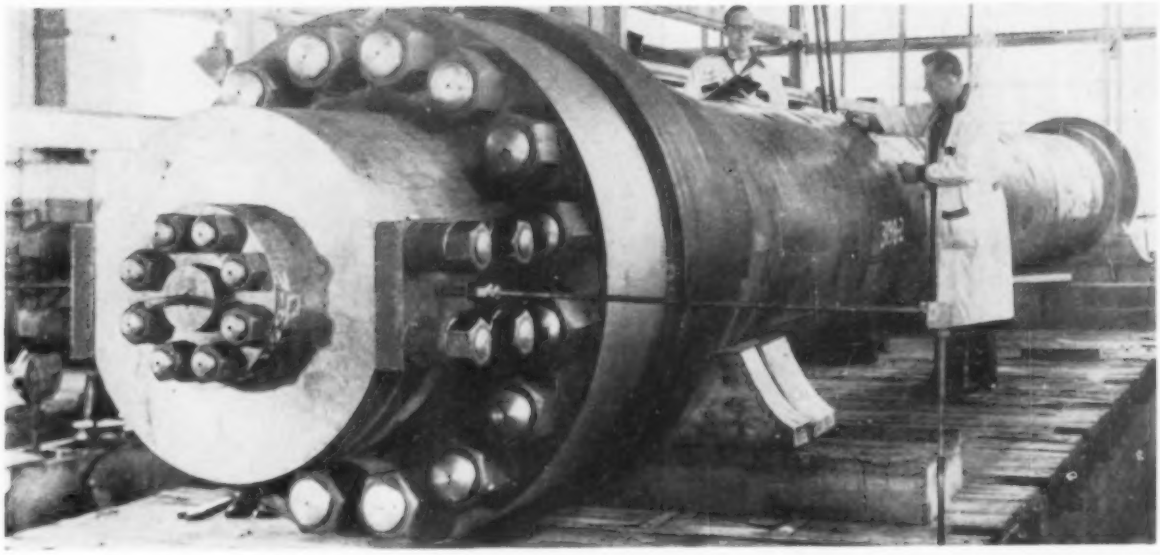
First, to define the problem. Chart 1 shows shell thickness increases with rising pressure. Certain limits were chosen to make the illustration clear. These are:

1. Temperature: constant, below 650 F.
2. ASME Code stresses.
3. Inside diameter: Constant at 30 in. Tolerances and corrosion ignored.
4. Material: ASME SA-212 Grade B, with a working stress of 17,500 psi. This material was chosen because it is the most common of the high-strength carbon steels.
5. Shell: Assumed to have been rolled to a cylinder, with the longitudinal edge double butt welded. This arrangement was picked so that the effects of stress relief and radiographing would not be ignored. For the SA-212 material used:
   (a) For this 30-in. shell, stress relief is required over .667 in. wall thickness.
   (b) X-ray is required when wall thickness exceeds 1 in.
   (c) Note that as shown by the chart stress relief was required over 600 lb and both stress relief and radiographing were needed over 800 lb. These operations rapidly increase the cost of these high pressure vessels.
6. End conditions were ignored. Flanging and sealing at high pressure is an art in itself, and will be discussed later in this article. We are assuming here that the problems of flanging and welding of the seams of the shell have been solved.

Chart 1 begins to illustrate the problem. At about 3000 lb, plate thicknesses start to get out of hand. Rolling of plate over three inches thick is beyond the capacity of many of the smaller shops engaged in this work, though a few companies, like Babcock & Wilcox, can form plate up to seven inches thick.

If the required thought and development is expended on this problem, the construction of high pressure vessels will not be forfeited to this small minority of shops.

Some remedies for the situation illustrated in Charts 1 and 1-a are immediately obvious. One solution would be to increase the strength of the material used. In this way, the necessary thickness of plate would be reduced. The fallacy is that the shops cannot roll even the reduced thicknesses of this stronger plate — if it is stronger, it also requires stronger rolls. Another solution is to reduce the diameter of the vessel, and to permit the use of seamless shells. Chart 2 shows the effect of diameter reduction. This chart has all the limits of Chart 1, but the inside diameter considered is only 10 in. For this small diameter, the shell would be made



A multiple-layered vessel being set up for a 19,000 psig pressure test.
— Courtesy A. O. Smith Corporation

Chart 1. Shell thickness must increase with increasing pressure as shown in this chart.

Chart 1-a. The effect of prestress on required wall thickness is shown here.

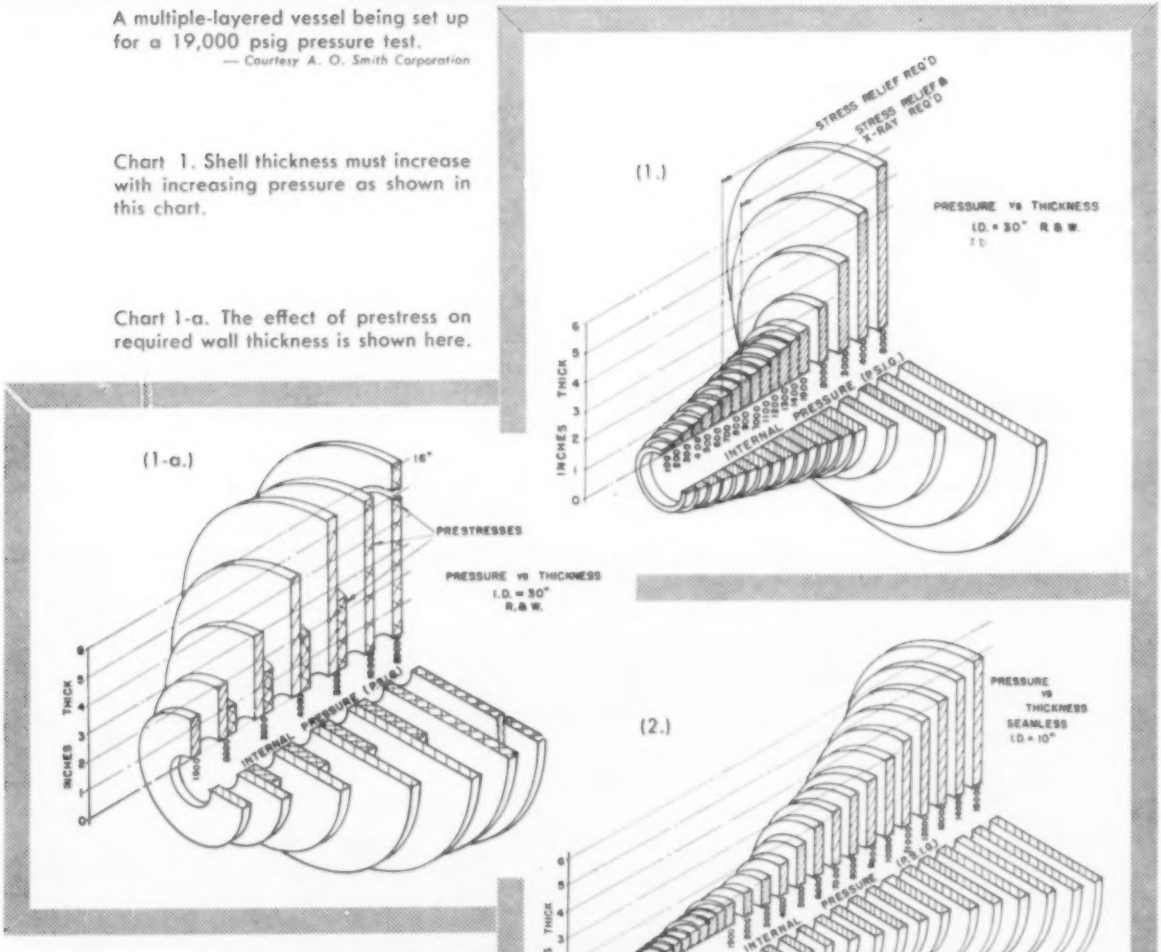



Chart 2. Effect on strength of diameter reduction on shells.

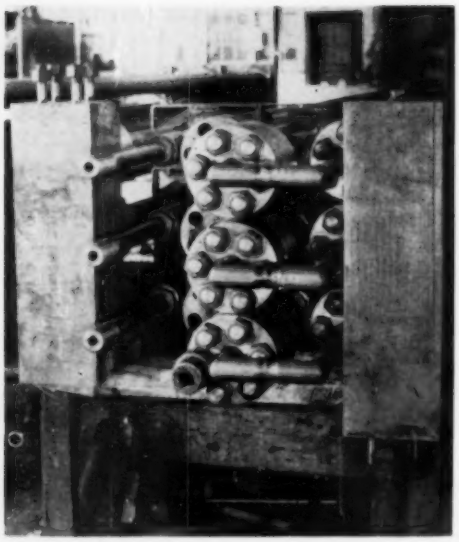


Fig. 1. A view of flanges with non-yielding gaskets, in units designed for 13,300 psig, tubing is 1-in. ID, 2-in. OD.

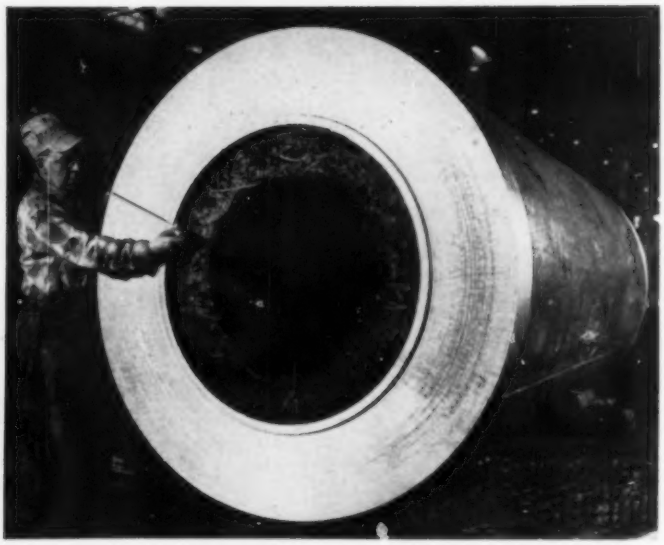


Fig. 2. Making up a shell 13 ½ in. thick, by wrapping progressively thin steel plates on inner core, and welding. — Courtesy A. O. Smith Corporation

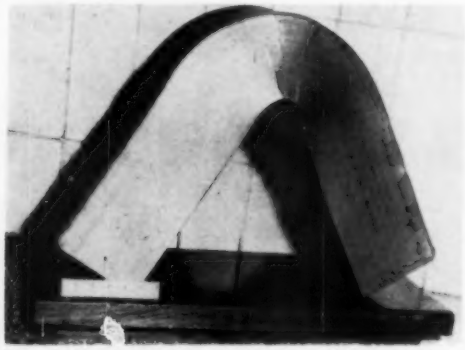


Fig. 3. A shell plate 6½ in. thick is tested by bending; this plate became the inner shell to which strips were welded to make a 15-in. vessel. — Courtesy Babcock & Wilcox Company

Fig. 4. A 6000 psig exchanger shell 26½ in. ID, which has been wound with narrow strips to give required strength. — Courtesy Vickers-Armstrong, Ltd.

of seamless pipe. In the thicker walled pipe shells, the pipe is made by piercing a solid billet, with no rolling necessary. In this manner walls up to six inches thick are possible.

Of course, this solution reduces the fluid carrying the capacity of each vessel. To obtain a capacity equal to the 30-in. shell, *nine* of these smaller vessels would be required. Also added are various interconnecting piping, pipe stresses, and expansion problems.

The author's company has constructed vessels for internal working pressure up to 13,300 lb, in what we call the Ultra High Pressure, "UHP"* range. In order to do this, it was necessary to use seamless pipe, or tubing, so that rolling was not necessary. The inside diameter was one inch. Fig. 1 shows a set of these high pressure exchangers, to be tested to over 19,000 psi.

These exchangers are available as a standard item, showing that if the limits can be altered sufficiently, working pressures can be raised easily.

Another solution is to take the thick wall required for high pressure, slice it into rollable thicknesses, form the

*Trademark.

thinner plates, then put it all together again. In this manner, wall thickness up to 15 in. can be fabricated. The A. O. Smith Company and the Babcock & Wilcox Company have developed such processes. A thick-walled vessel is constructed by adding successive layers of easily handled thin plate to a base cylinder. Figs. 2 and 3 illustrate these processes.

This method of thick shell manufacture solves effectively the problem of rolling or pressing thick plates. It does, however, require the use of special equipment capable of handling the sheets and properly forming the layers into an acceptable shell wall.

A method of simplifying the handling problem would be to cut these thin sheets into narrow strips, or bands. These bands could be wound back and forth over the base cylinder, like thread on a spool, to form the wall thickness required. In this manner, the Vickers-Armstrong Company of South Marston, England, has made shells as much as 15 in. thick, as shown in Fig. 4.

All these processes lead to a large, extremely heavy shell. A vessel 24 in. ID with a 10-in. wall would weigh more than one ton for each foot of length, for the shell only. Including tubes, flanges, and heads, weight would go over two tons per foot, so that a 10-ft vessel might weigh 40,000 lb, for only 24 in. ID.

It must be realized that the pressures under consideration are beyond the limits of the unfired pressure vessel codes, since both ASME and API-ASME codes are applicable only under 3000 psi. It would be necessary to reduce the code safety factors, approaching stress limits as is done in the aircraft industry, or fatigue calculations instead of ultimate strength could be a base for design. The various pipe formulas, from a different viewpoint than the vessel codes, allow higher stresses and higher pressures.

A 50,000-lb-internal pressure vessel probably could be built today, if size was no problem; if weight and handling were no problem; if cost was no problem. But these are points, particularly that of cost, which can eliminate a design. Without these questions reduced to acceptable answers, the 50,000-lb vessel is beyond our reach.

A solution that has been suggested, one that seems to show promise, is prestressing. That is the method of applying a stress to a part while in the process of manufacture.

**The Author**

Raymond Meyer is an authority on the design of vessels for use in extremely high pressure and temperature services. An engineer with the Griscom-Russell Company for the past five years, he received his BS in mechanical engineering from the Polytechnic Institute of Brooklyn in 1951. His army service included one year with the Twentieth Armored Division. Hobbies include model railroading, furniture design, and choral work. He lives near Massilon in Canton, Ohio.

This stress, in the opposite direction from the working stress, is applied to the part before operating forces are applied.

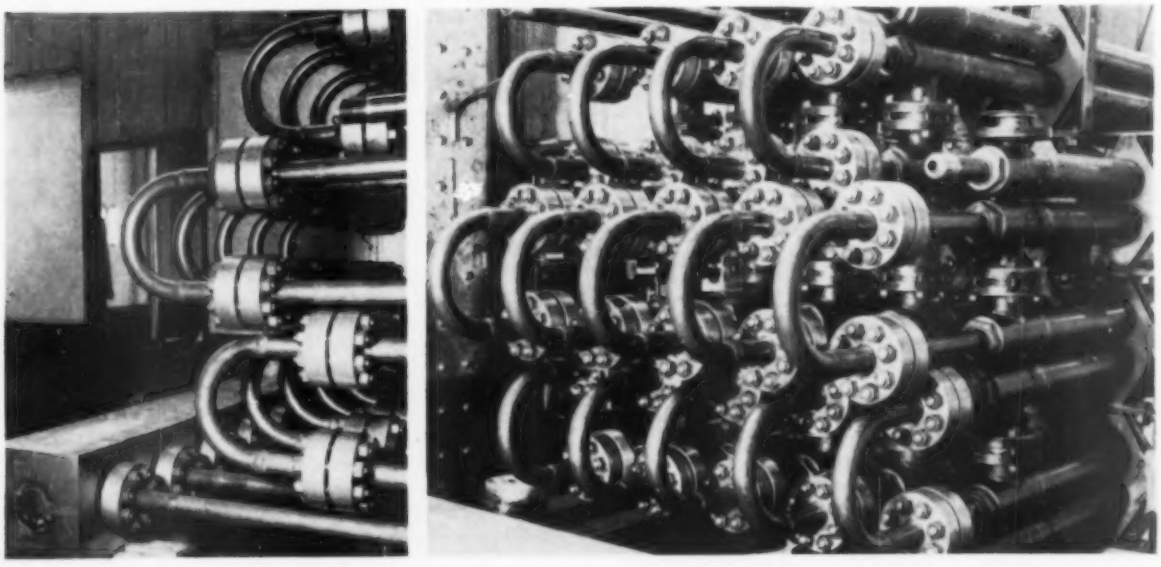
If a shell can be put into compression before internal pressure is applied, then this prestressed shell can contain a much higher pressure. The steps in development would be:

1. Assume the material is capable of being stressed to say 17,500 psi, either in compression or tension, and that creep (developed in some materials at some temperatures) is not present.
2. At 10,000 psig internal pressure the metal is under a 17,500 psi tensile stress.
3. First place the material into a 17,500 psi compressive prestress.
4. Then an internal pressure of 10,000 psig will bring the material to a condition of zero stress.
5. An additional internal pressure of 10,000 psig might then be applied to bring the metal to the limit of 17,500 psi tensile stress.
6. In this manner the *same weight and dimension* of shell could hold twice the pressure — 20,000 psig instead of 10,000 psig.

Chart 1-a shows the effects of prestress.

Coupled with this method of securing higher pressures in the same shell dimensions would be the use of banded

Fig. 5. (a) side view, and (b) front view of flanged connections designed for 10,000 psig, using soft, fully confined gaskets.



shell construction. The bands of steel being wound on the shell would be heated as they are being wound, and as they cooled and contracted, they would place the shell in compression. By proper use of temperature, the required prestress could be applied.

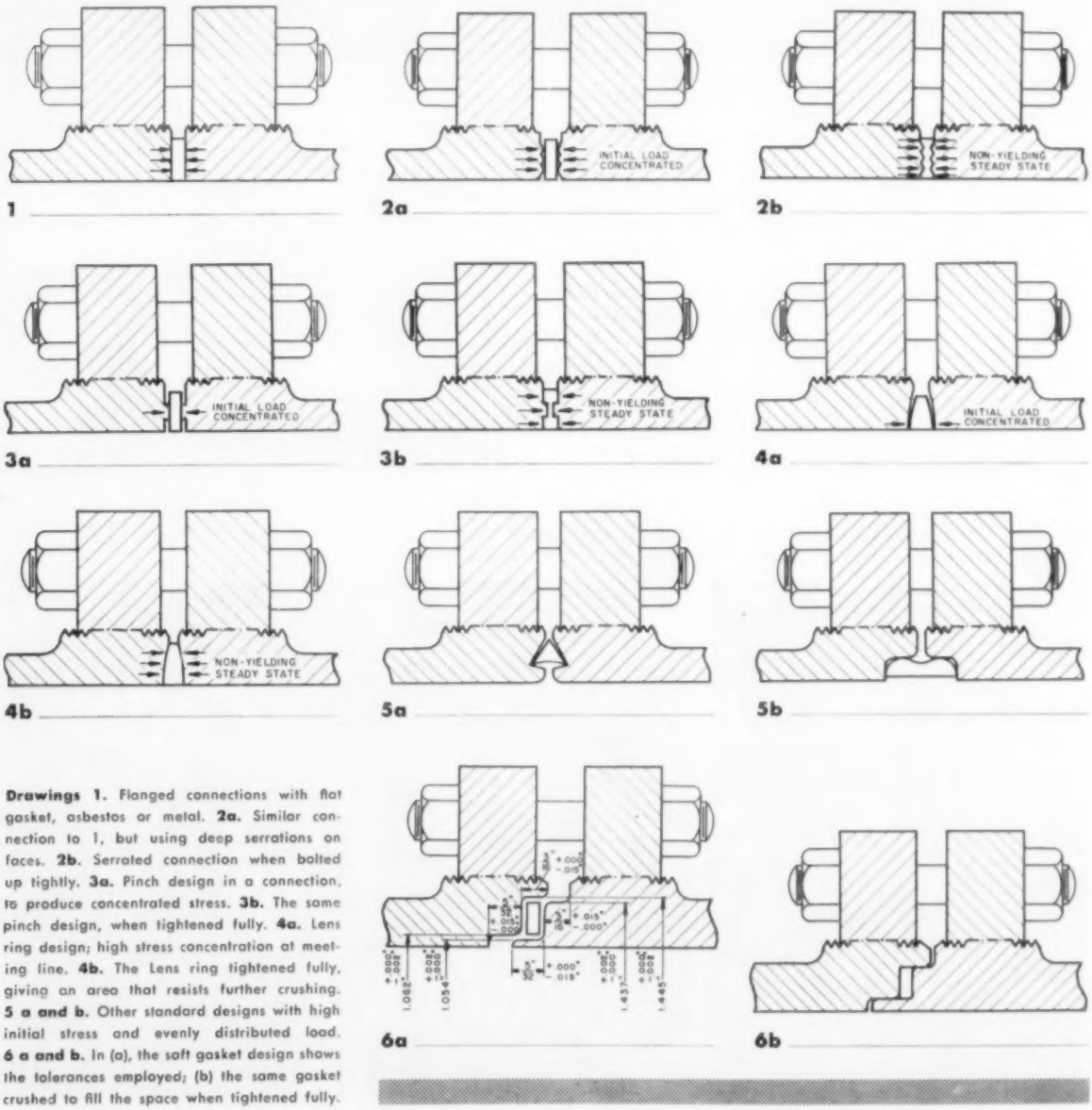
Note that this combination of prestress-by-heat and banded shell construction requires no special heavy equipment, so the process would be adaptable to the use of the smaller shops. Of course, the process outlined above is not complete, but parts of it are standard practice. Continued research is necessary to develop a usable process.

We can see, then, that methods of design for high pressure vessels are available. In some cases they are proprietary, or the methods require expensive, heavy machinery. It is merely a matter of time before acceptable general processes will be brought to common use. That time is approaching rapidly.

With these methods of designing and manufacturing high pressure vessels being successfully developed, the design engineer finds himself faced with yet another problem, that of flanging and gasketing. Conventional concepts in this field will not stand up under the exigencies of pressures above 10,000 psi, in the UHP range.

For convenience we can call pressures up to 1000 psi High Pressure, or "HP"; up to 5000 psi Very High Pressure, "VHP"; up to 10,000 psi Quite High Pressure, "QHP"; and over 10,000 psi Ultra High Pressure, "UHP".

Standard flange design employs the principle of "non-yielding" gaskets: A gasket is designed to have its surface yield up to the point required to seal the joint as the flange bolting is drawn up; then at a specific, predetermined point the gasket ceases to yield and without further crushing must withstand all the additional load imposed by the flange. The flange




**Drawings 1.** Flanged connections with flat gasket, asbestos or metal. **2a.** Similar connection to 1, but using deep serrations on faces. **2b.** Serrated connection when bolted up tightly. **3a.** Pinch design in a connection, to produce concentrated stress. **3b.** The same pinch design, when tightened fully. **4a.** Lens ring design; high stress concentration at meeting line. **4b.** The Lens ring tightened fully, giving an area that resists further crushing. **5 a and b.** Other standard designs with high initial stress and evenly distributed load. **6 a and b.** In (a), the soft gasket design shows the tolerances employed; (b) the same gasket crushed to fill the space when tightened fully.

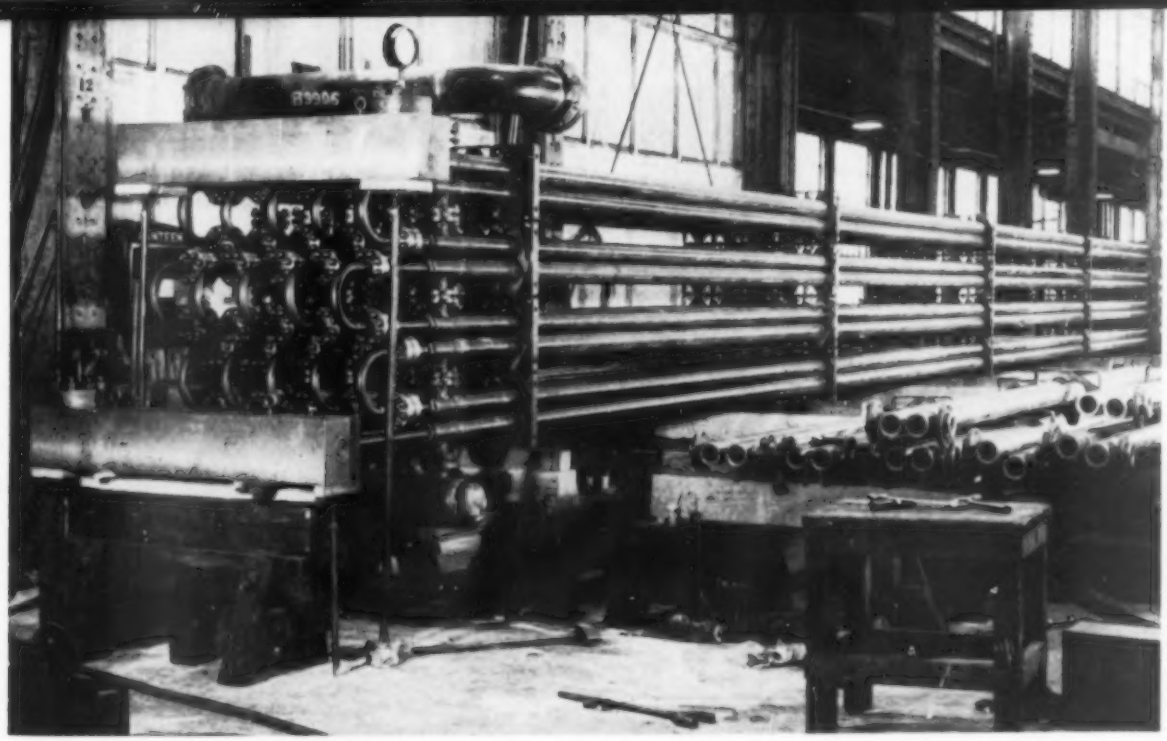


Fig. 6. Another type — thin, long exchangers utilizing the soft gasket principle.

face, of course, must be harder than the gasket material, to prevent scoring or deformation, and at the same time forcing the gasket to yield for proper sealing.

As we employ this concept into the higher pressures, approaching 10,000 psi, we are faced with a number of problems. A point finally comes when the gasket is so hard that the flange cannot be made any harder. Tempering and face hardening are of limited application. Also, the flange soon becomes outlandishly large. The flange of Fig. 1 designed for service at 13,300 psi and employing the non-yielding gasket concept is an example. This one-inch ID tube required a flange 9⅛ in. OD, 4½ in. thick, with eight bolts each 1½ in. diameter.

The accompanying illustrations show a number of variations on this "non-yielding" theme. Designers, recognizing its shortcomings have attempted to modify this idea in an attempt to bring it up into the pressure ranges approaching 10,000 psi. Drawing 1 shows the common flat gasket. No part of this one yields, other than the minor flattening occurring as surface imperfections are smoothed out.

A number of methods have been used to cause temporary stress concentration on the gasket, thus producing an initial flow and a resultant perfect seal. These are shown in Drawings 2, 3, 4 and 5. Most of these methods are familiar to design engineers who have employed them successfully in ranges up to 10,000 psi.

The answer to all these gasketing problems lies in an entirely new concept of high pressure gasketing. Once it was realized that pressure loads in the UHP range would stress any gasket material beyond its yield point, the way was open to changed thinking. A flange had to be designed around a gasket that would yield. The result was the soft, fully confined gasket. A flange employing this gasket that is equivalent to the one shown in Fig. 1 would be only 6⅜-in. OD, 1 15/16-in. thick, with eight bolts only ¾-in. diameter. Such a connection is shown in Drawing 6-a and 6-b.

There are several reasons why we have been able to reduce the dimensions of the flange so drastically. With the earlier non-yielding concept the flange dimensions are determined by two loads. The first is the load applied by the flange bolting to resist internal pressure. Added to this is the now unnecessary load required to press the gasket hard enough to obtain the initial yield to seal the joint. In most cases in UHP ranges the flange dimensions are determined more by the requirements of the gasket than by the internal pressure, a case where the cart is pulling the horse. With the soft, fully confined gasket the force required to compress the gasket is so slight as to be negligible — we have eliminated the cart altogether.

Of course, this gasket must be fully confined. Radial dimensions must be held to plus or minus .002 in., as shown in Drawing 6-a, but this is no problem for modern machine tools.

With the gasket seat totally enclosed, there no longer is any relationship between gasket material and contained pressure. A soft aluminum, copper, or rubber gasket can safely contain pressure in the UHP range. Here, the gasket is performing its primary function, that of furnishing a fluid seal. It is not also adding a large undesirable flange loading. The flange designed to hold the longitudinal internal pressure will definitely compress the gasket. Drawing 6-b shows the general arrangement of such a flange.

What exactly happens when this flange is bolted up? First the gasket is crushed and extruded — it is made to fill every part of the confining space. We secure perfect sealing, as all of the gasket material flows. Then when the confining area is completely filled, the gasket resists further compression, resulting in the counterbalanced forces necessary for a connection that will remain tight under field conditions.

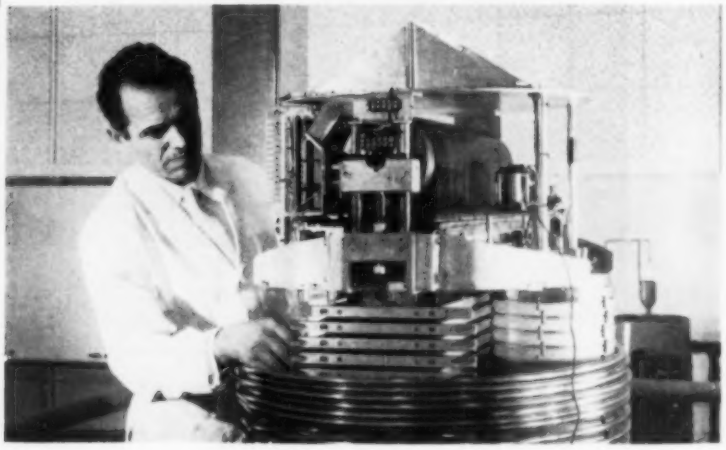
Fig. 6 shows some particularly long double pipe exchangers, (60 ft long) designed for 10,000 psi tube pressure and employing these new gasket concepts. Test pressure was 15,000 psi.

With these new concepts of manufacture and design of high pressure vessels and their connecting elements, process engineers can progress up into the ranges that previously were unattainable. The steps from theory to drawing board have been shortened by non-conformist thinking. ★ ★ ★

♦ Greetings were extended by Dr. Harold Gershinowitz, president of Shell Development Company.

First stop on the tour was the radiation laboratory which houses Shell's new 3,000,000 volt Van de Graff electron accelerator. Industry's most powerful radiation source, it has more than 50 times the ionizing power of the largest cobalt-60 source in use.

▼ A rubberized belt traveling at 360 rpm carries electrons to the stainless steel "storage" dome which normally covers this part of the machine. The storage dome is set into position. ♦ After the desired voltage is reached, electrons are "shot" from the dome through a vacuum tube to the target.

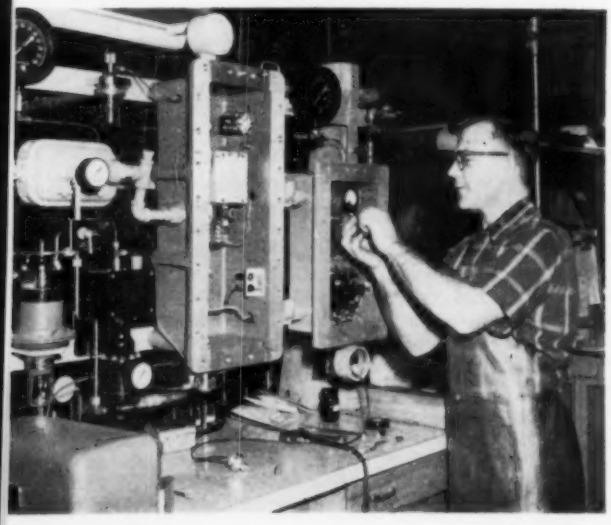


★ *Selected for Merit*

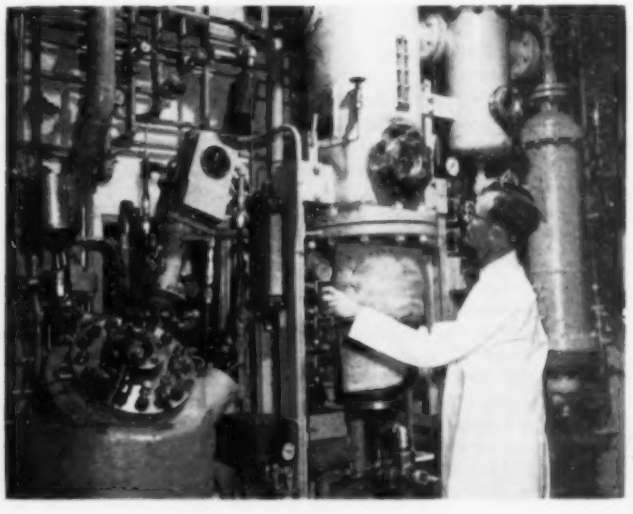
# SHELL DEVELOPMENT HOLDS OPEN HOUSE

Shell Development Company unveiled to the public press its new, 3,000,000 volt Van de Graff electron accelerator at an open house held at the Emeryville, California, central research laboratories. More than 50 representatives of national magazines and well-known newspapers attended the laboratory tour, which included several sections of the modern research facility. Shell did a grand job of illustrating to mass-media representatives the intensive research efforts that are being made in the fields of refining and petrochemicals.

▼ Shell Development's Instrumentation Department designed and built this continuous vapor pressure recorder. Unit is in service at Shell's new Anacortes, Washington, refinery.



▼ A synthetic rubber pilot plant. The chemist is operating a latex stripper which removed unreacted monomer from latex. The polymerization kettle is on the left.

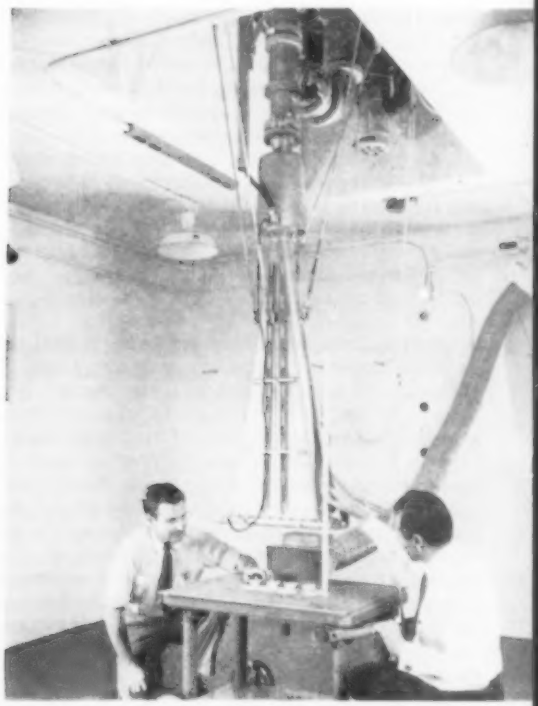


The inner workings of the accelerator are covered by a tank. Here, an assistant adjusts the hoses that carry chilled water to the cooling system.

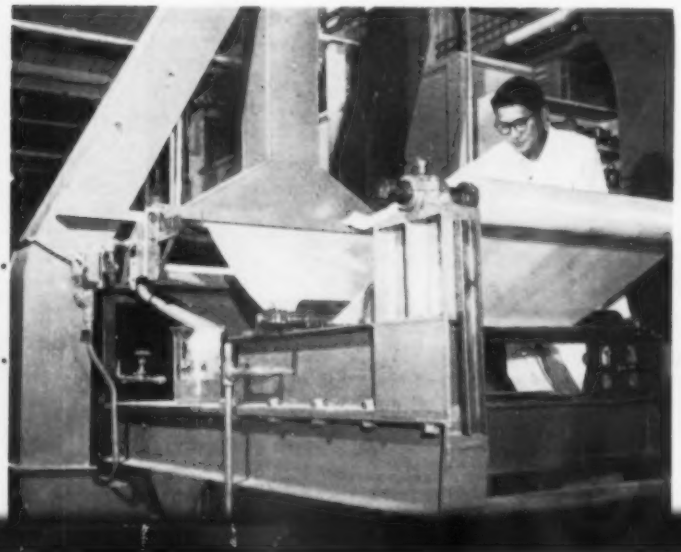
The scanning tube is a floor below the accelerator. Here, it is positioned above samples that are to be bombarded. A vent tube withdraws ozone generated by the electrons when they strike the air.

$\frac{d^2\alpha}{dt^2} + (\frac{\pi}{65})^2\alpha = 0$
$t=0: \alpha=0, \frac{d\alpha}{dt} = 100\times\frac{\pi}{65}$
$\frac{d^2\beta}{dt^2} + (\frac{\pi}{5})^2\beta = 0$
$t=0: \beta=0, \frac{d\beta}{dt} = 100\times\frac{\pi}{5}$
Solve $Y=f(x)$ where :
$X = \frac{1}{\phi(\alpha)}\frac{65}{\pi}\frac{d\alpha}{dt}(1+0.04|\beta|)$
$Y = \frac{\phi(\alpha)}{\alpha}(1+0.04|\beta|)$
for $0<t<65$
$\phi(\alpha) = 25+0.07\alpha$ for $\alpha<58$
$\phi(\alpha) = \alpha$ for $\alpha\geq 58$

Given this equation, a differential equations analyzer in the math lab sketched the well-known Shell emblem.



This machine in the plastics and resins laboratory coats glass cloth with EPON® resin for use in industrial tests. These laminates are used for making die castings, boat hulls, auto body parts, and aircraft radar domes.



# Lubricating Oils:

## PROPERTIES & APPLICATIONS

### Viscosity Index, Pour Point, Oiliness, Heat Stability are among the all-important properties of lubricants

Chapter XIV

**V. A. Kalichevsky**
*Consulting Chemical Engineer*

LUBRICATING oils include a large number of liquid petroleum products which have been developed for lubricating various types of machinery. Practically all moving mechanisms must be lubricated to keep them in operation. The adaptability of petroleum oils to this service was and is an important factor in speeding the progress of our civilization and in providing us with everyday comfort.

Petroleum oils are used for lubricating almost all types of machinery from the delicate mechanisms of watches to rough devices like pulleys. These diversified applications require production of a large variety of lubricants. Some of these lubricants find a very limited market and must be regarded as specialties. The discussion below is confined to the most important classes of lubricants, particularly to those used in internal combustion engines that absorb a large volume of petroleum products.

Lubricating oils must meet a number of requirements. One of the most important requirements is that they circulate freely in an engine. The free flow is determined by the fluidity of the oil and by its tendency to "freeze" or congeal at service temperatures. These and other properties of lubricating oils must be carefully adjusted.

### Viscosity

Instead of measuring fluidity or ease of flow, petroleum chemists measure the opposite property, viscosity, or resistance to flow. In layman's language viscosity is often referred to as the "body" of the oil. Some people try to evaluate it by rubbing the oil between the fingers. Such a primitive test is misleading. Special instruments must be used to evaluate the oil quality and its service characteristics.

Viscosity is measured by allowing the oil to flow through a small tube under standardized conditions. The number of seconds required for a standard volume of oil to pass through the tube is reported, specifying apparatus, temperature and procedure used. The most popular viscosimeter is the Saybolt Universal instrument. For instance, an oil having a viscosity of 50 Saybolt Universal seconds at 210F is an oil 60 cu cm of which flow in 50 seconds through the standard tube at 210F. The greater the number of seconds, the higher the viscosity of the oil and the heavier its "body." Other methods are also used for measuring oil viscosity. In all instances higher numbers correspond to higher viscosities, except for the Barbey instrument formerly used in France, where the readings refer to fluidity and are in reverse direction. For simplifying the comparisons, viscosities are measured at standard temperatures, at 100F, 130F, and 212F in this country and at 50C (122F) and 100C (212F) in Europe. These temperatures do not correspond to those prevailing in the engines and extrapolation must be made for determining whether or not an oil will lubricate properly under the service conditions.

Automobiles of different makes or in varying mechanical conditions require oils of different viscosities to insure their best performance. Many motorists pride themselves that their cars consume no oil. By making such economies they penalize themselves with heavy repair bills. Unfortunately some of the automobile manufacturers are stressing low oil consumption of their cars. Oil companies are forced to follow their example and make similar claims regarding the products they sell in order to meet competition.

The car which is bought new is usually resold in a couple of years. During this short period of time defective lubrication may not cause visible damage to the car, but the per-

**Petroleum fractions from which lubricating oils are refined are vacuum distilled to specifications in units like this double-column fractionator.**

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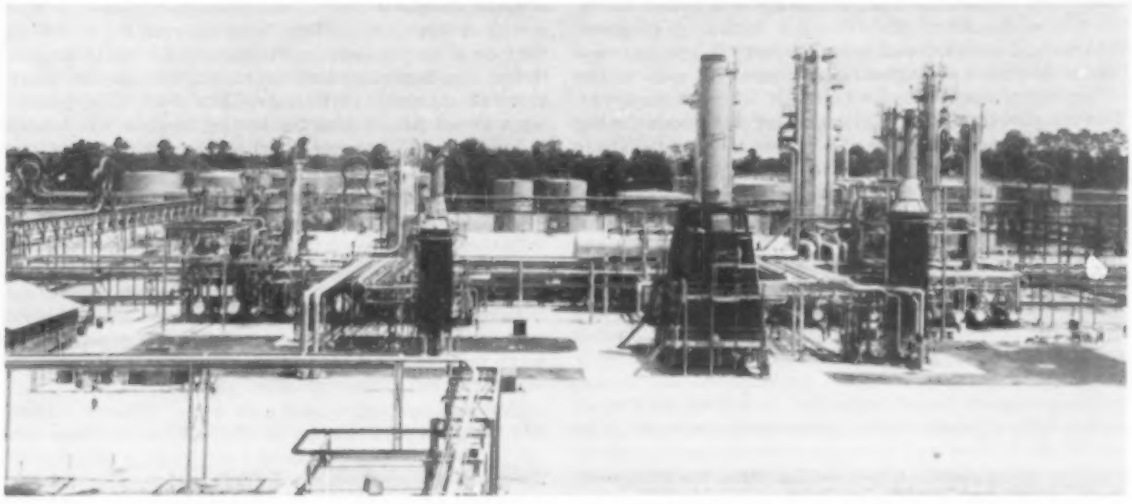

Asphaltic impurities in lube fractions are removed by propane solvent in one of these two units; in the other phenol (carbolic acid) is the solvent used to separate the low viscosity index components from the high V.I. material used for lubricating oils.

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son who bought a second hand car may find in a short time that the engine must be overhauled. Instead of realizing the true cause of his difficulties, i.e. the use of a high viscosity oil in a new engine, he is liable to blame the former owner for abusing the car.

Contrary to the rather prevalent opinion, the greatest wear of the engine does not occur when the car is on the road, but during the first few minutes just after the engine is started and before it is up to the normal driving temperature when free oil circulation is established. Every driver knows that fast driving while the engine is cold is very harmful to the life of a car, as the oil does not reach all parts of the engine and metal may rub against metal. The use of low viscosity oil reduces this time to a very considerable extent and protects the engine. After the car is on the road, less power is lost to friction, thus increasing mileage.

The above explains also the reason why low-viscosity oils are recommended in winter and high-viscosity oils in summer. This is done with the purpose of adjusting oil viscosity to the average temperature prevailing during the various seasons of the year. However, for most cars winter oils are satisfactory for summer use but summer oils are not suited for winter use. Many new cars give best overall results when the lightest grade winter oil is used during both winter and summer months provided the driver is willing to consume one or possibly two quarts of oil for every thousand miles. Consumption is higher in the summer than in the winter as well as in continuous driving at high speeds. However, if heavy oil had previously been used in a car, higher clearances are established between the moving parts of an engine and if heavy oil is replaced with a light oil, the oil consumption may prove prohibitive.

The viscosity of motor oils sold at service stations is expressed in the so-called SAE (Society of Automotive Engineers) numbers. The lightest grade of winter oil is assigned a number of SAE-10W. SAE-20W is the heaviest grade of winter oil. SAE-10 and SAE-20 without the letter W, have the same viscosity as the above oils but they congeal at a higher temperature, i.e. they have a high pour point the significance of which is explained below. This makes them suitable for summer but not for winter use. SAE-30 and SAE-40 are summer grade oils. SAE-50 and higher numbers are used if a car has had an exceptionally heavy wear. No intermediate grades between those mentioned are in existence as finer differentiation is of no practical significance.

### Viscosity Index

Viscosity of the oil decreases with the rise in temperature when the oil becomes more fluid. An "ideal oil" must have the same viscosity and should flow through the engine with an equal ease at all temperatures, but this product does not exist yet. The closer the oil approaches this ideal, however, the better service it will give. In practice, viscosity of the oil is adjusted so that it lubricates the engine properly at its normal operating temperature.

A change of viscosity with temperature is reported in terms of viscosity index. The system has been devised in an arbitrary manner, like octane number or cetane number, but is convenient because it is based on practical experience. Since Pennsylvania oils were considered for years to show least change in viscosity on heating, their viscosity index was assigned a value of 100. Coastal oils, on the other hand, which show the greatest change in viscosity with temperature were assigned a value of 0. Oils falling between the two are given the intermediate value indicating their relative position with respect to the two standard oils. Although new refining methods permit manufacture of oils that have a viscosity index considerably over 100, the system is still used widely because of its simplicity and adaptability to extrapolations below or above the originally established limits.

Application of the viscosity index scale to motor oils requires additional clarification. Viscosity changes with temperature for standard Pennsylvania and Coastal crude oils vary with the viscosity of the fraction. The differences between the two crude oils are less in the low than in the high viscosity range. Consequently it is much easier to show a numerical improvement in the viscosity index of a low than of a high viscosity oil. For instance, an "ideal oil" that has a viscosity index of 40 Saybolt Universal seconds at all temperatures will have a viscosity index of 269, while an "ideal oil" of 160 Saybolt Universal seconds at all temperatures will have a viscosity index of 158. This shows that the divisions on the viscosity index scale for the heavy oil are $269:158 = 1.7$ times the size of the divisions of the viscosity index scale for the light oil. The numerical values of the viscosity index scale are thus not indicative of the change in oil viscosity with temperature unless viscosities are known.

The viscosity index scale has very small divisions. These divisions are too small to be of practical significance. At

least 10 to 15 divisions must be passed on the scale before the engine can detect the difference in this oil property. When an oil is introduced into the engine it becomes contaminated with heavy gasoline fractions and such blends have a higher viscosity index than that of the oil employed. This is a pure blending phenomenon and it is working to the driver's advantage. Because of all these complications it is best to rely on the reputation of an oil company rather than on one's own judgment.

### Congealing Characteristics

The next important physical characteristic of an oil is its ability to remain liquid at low temperatures that may be encountered in service. Oils containing wax congeal and cannot be circulated freely when the temperature is lowered below a certain point. In the laboratory this property is measured by the pour point.

The pour point is the temperature in degrees Fahrenheit at which the oil stops flowing under specified experimental conditions. If these conditions are not observed, such as the size and shape of vessels and cooling rates, the pour point readings will vary within wide limits. Interpretation of the results of pour point determinations in terms of engine performance must be done with caution. If the pour test shows that the oil stops flowing at a certain temperature, it is not an indication that it will stop flowing at the same temperature in the engine. This may occur at a lower or at a higher temperature than that of the pour point depending on the engine design. For instance, the pressure under which the oil is fed to the engine is an important factor affecting the oil flow, so are the diameters of pipes.

The cloud point is sometimes determined together with the pour point. The cloud point is the temperature at which the oil begins to cloud because of separation of crystals of high melting point waxes. High cloud point may also indicate that the oil contains traces of moisture. Interpretation of the cloud test is somewhat difficult but this is seldom of practical importance except for solving specific plant problems, such as isolating leaky filters in dewaxing units.

### Oiliness, Stability and Other Properties

The oil should have an important property known as "oiliness." It expresses the ability of an oil to form a tenacious film on and around metal surfaces from which they may be squeezed out by excessive pressures. Such conditions exist in certain types of machinery and in automobile engines during the break-in period. Special break-in oils possessing high oiliness are used in new engines for this reason. The importance of these oils disappears after proper clearances are established.

The oil must not be corrosive and should have no adverse effect on the metals from which the engine is made. This requirement is opposite to oiliness because substances that stick best to metals are those that are attracted chemically, i.e. those that are corrosive. A satisfactory compromise is reached by the proper selection of additives.

The stability of oils, that is, their tendency to remain in their original condition, affects the frequency at which the oil must be changed. Present oils are very stable in service. Stability of an oil does not guarantee its satisfactory performance in an engine, however. The oil accumulates abrasive materials, such as dirt from the road or small metal particles chipped from the moving parts of the motor. Frequent oil changes are desirable: The oil is cheap and engine repairs expensive.

On evaporation, lubricating oils should leave as little carbonaceous matter as possible. This property is determined in the laboratory by means of special tests. The "carbon residue" test is used in the United States and the "coke number" test in England. The lower the carbon residue or the coke number of an oil, the better are supposed to be its service characteristics. These tests, however, fail to indicate the type of carbon deposits. Fluffy carbon is easily removed through the engine exhaust, but hard carbon stays in the engine and impairs its performance. Therefore, an oil possessing a low carbon residue but leaving hard carbon deposits is inferior to an oil having a high carbon residue but depositing fluffy carbon in engines.

Many laboratory oxidation tests have been developed to predict the rate of deterioration of oils in service. These tests are by necessity accelerated. Some oils, like those used in oil field cables, must last 20 years and longer and their testing under service conditions is impractical for plant and laboratory purposes. Besides service tests are expensive and require large volumes of oil. A laboratory can produce many samples per day and their properties must be evaluated with a reasonable speed.

Unfortunately accelerated tests do not necessarily correlate with the performance of oils in engines. These tests are carried out under artificial conditions by exaggerating the effect of the various factors that are responsible for the instability of oils in service. Elevated temperatures, high oxygen concentrations, large quantities of catalysts are used. This assumes that the chemical reactions responsible for the deterioration, that is "aging" of oils, accelerate proportionately to the severity of testing conditions which is incorrect. An oil that satisfactorily passes the laboratory tests may be inferior to an oil which does not pass them. This requires extreme caution in selecting the oxidation tests for each particular need. Large companies spend much effort for testing oils both in the laboratory and in the field. The brand of oil is the only true guide for the customer in selecting the best product on the market.

The accelerated tests are applied with a greater certainty to the control of plant production than to the solution of research problems. Variations in the results of such tests indicate that the quality of the product changed. The change may be due to fluctuations in processing conditions or in the quality of charge stock. The accelerated tests assist, therefore, in maintaining a uniform production.

The oil must meet a number of additional specifications, such as flash and fire points, color and tests specific to the field of their application. Flash and fire points are the temperatures at which oil flashes or ignites under the specified experimental conditions. Different instruments give different readings which are not convertible. Fire point is normally about 40F to 50F higher than the flash point. The difference is greater for high-viscosity than for low-viscosity oils. Good fractionation narrows the spread between the flash and fire points. These tests were developed for indicating safety from fire hazard. Oils having low flash and fire points might be consumed faster by the engine than oils having high flash and fire points but other factors have the same or greater effect in this connection.

The color and fluorescence of an oil have no relation to its performance. The light colored oils are preferred by the trade and the refiner must meet the public demand even if it has no practical significance. Besides his products must appear uniform to the eye. Color determination is a quick test, often valuable in plant control.

Color is determined by passing the light through an oil layer of definite thickness and comparing it with a standard color. Several colorimeters were developed for this purpose but their readings are not convertible. This happens because the shades of the oil and the standard color discs seldom match. The readings are, therefore, to a considerable extent arbitrary. For instance, if an oil has a greenish tint and the disc has a reddish tint the two colors will not look alike to the eye. The type of the instrument used in color measurements must be reported.

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Fluorescence, "bloom" or "cast" refer to the appearance of the oil when the light is reflected from its surface. Green fluorescence is typical for Pennsylvania oils and blue fluorescence for Coastal oils. This does not mean that fluorescence of the oils leaving a refinery is an indication of the crude oil source from which the oil is made. Fluorescence changes on refining and also can be altered by adding dyes. Fluorescence is determined by visual observation. Instruments are available for measuring it, but they did not find wide application in the petroleum industry.

The deceitful nature of color tests may be illustrated by the following example. An oil having a transparent color but lacking fluorescence will expose to the eye all particles of carbon and foreign matter it carries in suspension. After a brief service it will look dirty and dull although its lubricating quality is still excellent. Another oil having good fluorescence will reflect the light from the surface concealing the suspended matter from the observer's eye. The highly fluorescent oil may be unfit for service and look attractive, while the oil lacking fluorescence and usable may be discarded. Moreover, many substances which give to the oil the desired fluorescence form carbon in engines and may be harmful if used in excessive quantities.

Lubricating oils are used for lubricating diversified machinery and are made in very many grades. A "universal lubricant" is a dream of machine operators but the possibility of developing it is no better than that of finding a "universal solvent." In broad terms the oils may be divided into those used in intermittent and in continuous service. Some of the requirements from these oils are common for each group.

Oils used for intermittent service are represented by motor oils already described. Aviation oils are similar to motor oils but they must withstand severe service conditions created by air-cooled motors of high power output. They have higher viscosities than motor oils on account of high operating temperatures. All these oils must lubricate engines over a wide temperature range. Cold motors must be brought to the operating temperature as often as several times a day and the running periods may be short. This explains why the viscosity index of these oils is important.

Oils used for continuous service are employed for lubricating industrial machinery. They are often referred to as industrial oils. This machinery operates for months and even years at a constant temperature without stopping for an overhaul. Viscosity index of the industrial oils is of no significance as long as the machine can be started without excessive wear. Stability of the oils at operating temperatures becomes of considerable importance because most plants operate at a narrow margin of profit and the cost of lubrication may be an important item. So is the power consumption which may be high if improper lubricants are used. This shows that requirements for lubricating oils change with the type of service. The laboratory tests they have to meet must vary accordingly.

### Industrial Oils and Related Products

Oils showing considerable fluctuations in viscosity with temperature, such as Coastal oils, are often very stable in certain types of service. These oils are used in the formulation of industrial oils when oxidation stability becomes of greater importance than viscosity index. For reducing the cost of lubrication much experimental work is done for developing oils that are most economical. Some of the industrial lubricants are cheap and no attempts are made to recover them for re-use. But a cheap oil is not always the cheapest one in plant operation. Many oils can be recirculated after they are treated for removing foreign matter they might pick up in service. Expensive additives may be needed for protecting the machinery from wear and for reducing friction. Other additives might be used as anti-corrosion or anti-emulsion agents. In some instances, like with cutting oils, formation of emulsions may be advantageous. A thorough study of the process and of the machinery employed is necessary before an oil can be recommended for plant use.

Many of the petroleum products employed for lubricating machinery derive their name from their application. For instance, turbine oils are used for lubricating turbines, loom oils for lubricating looms, and watch oil for lubricating watches. Some of these oils must meet special requirements. For instance, loom oils should not drip as this may ruin the fabric on the loom. Certain additives are needed to produce such oils.

Not all the industrial oils must lubricate. The main function of transformer, switch and cable oils is to provide good insulation. They must be free of impurities and moisture which are conductors of electricity. Before they are placed in service, they are cleaned by passing through presses containing blotter paper. Some of the physical properties of such oils might be important in addition to their electrical properties and stability. For instance, pour point must be low if the oils are exposed to freezing temperatures. Specific gravity may be another requirement. With transformer oils specific gravity must be adjusted so that the ice sinks to the bottom and does not short-circuit the electric current.

Some petroleum products are used for protecting idle machinery from corrosion. They must prevent metals from exposure to air or water. Special chemicals may be added to these oils for improving their water-repellent characteristics and adhesion to metals.

Petroleum oils are employed as floatation agents. Minerals containing an embedded ore are finely ground to obtain particles of the two materals uncontaminated with each other. The resulting power is resolved into the two components by utilizing their difference in specific gravity.

Special oils are used for controlling mosquitoes. They may be used as solvents for dissolving active chemicals and then applied as a spray. Other oils employed for the same purpose are heavier than water and sink to the bottom of the pools where mosquitoes breed. For some unknown reason the larvae of the mosquitoes consider this oil a great delicacy and eat it, to their detriment.

Petroleum oils find wide application in agriculture. The oil sprays are made of two general types. Partially refined oils are effective on dormant plants. They cannot be applied to the growing plants because they interfere with the respiration. Highly refined oils are still sufficiently toxic for the insects but do not injure the plants. Such oils are usually applied in the form of water emulsions. Instructions regarding the application of these oils must be followed in detail in order to derive maximum benefit without hurting the plant. Toxicity of the oils to the insects is adjusted on the basis of the laboratory and field studies.

Petroleum products are useful preservatives for some farm products. Eggs can be preserved in storage by spreading a thin film of oil over their surface. This protects the inside from drying out and from diffusion of oxygen from the atmosphere through the egg shell.

Medicinal oils are drastically treated lubricating oils from which every trace of harmful substances has been removed. Oils similarly treated are employed instead of the expensive vegetable oils for preserving feed. Perfumery oils are also highly treated petroleum products.

The above shows some of the almost innumerable uses for petroleum products. More of them are developed every day. Many industries would stop or curtail their output if the volume of petroleum available to the trade is curtailed or its price becomes prohibitive.

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | **Allied Chemical and Dye Corporation** | | | | |
| Girdler Corp. | Same | Moundsville, W. Va. | Vinyl Chloride, Hydrogen, Carbon Monoxide | — | — | — |
| | | **Akron Gasoline Company** | | | | |
| Staff | Prengle, Dukler, and Crump | Akron, Colo. | Gasoline Recovery | — | $500,000 | — |
| | | **Aluminum Company of America** | | | | |
| ALCO of America | Prengle, Dukler, and Crump | Point Comfort, Tex. | Gas Processing | 100 MMCF/D | — | Spring 1957 |
| | | **American Gilsonite Company** | | | | |
| Foster Wheeler Corp. | Same | Grand Junction, Colo. | Delayed Coker | 4000 BPD | | Spring 1957 |
| H. K. Ferguson Co. | Calif. Research Corp. | " | Catalytic Reformer | 1750 BPD | $5,000,000 | " |
| " | Girdler Corp. | " | Hydrogen Unit | 550 MCF/D | | " |
| Kaiser Engineers | — | " | Coke Calciner | 250 T/D | | " |
| | | **American Oil Company** | | | | |
| Ralph M. Parsons Co. | — | Texas City, Tex. | Ultraformer | 21,000 BPD | — | Early 1958 |
| M. W. Kellogg, Lummus Co., Ralph Parsons | Same | Yorktown, Va. | Refinery | 35,000 BPD | $25,000,000 | Early 1957 |
| — | — | " | Asphalt Production | 25,000 BPD | — | Early 1958 |
| | | **Amoco Chemicals Corporation (Standard of Indiana Subsidiary)** | | | | |
| — | Scientific Design Co. | "Midwest" | Phthalic Anhydride, etc. | 60,000,000 lb/yr | $10,000,000 | 1958 |
| | | **Anderson-Prichard Oil Corporation** | | | | |
| Badger Mfg. Co. | Same and Esso | Arkansas City, Kan. | Propane Deasphalting | 3000 BPD | — | Late 1957 |
| — | — | " | Crude Distillation | 25,000 BPD | — | — |
| — | — | " | Expand Cat Cracker | 2500 BPD | — | — |
| Procon, Inc. | Same and UOP | Cyril, Okla. | Catalytic Cracker | 5000 BPD | — | March 1957 |
| | | **Ashland Oil and Refining Company (Frontier Oil Refining Division)** | | | | |
| Blaw-Knox Co. | Ashland and UOP | Buffalo, N. Y. | Platformer | 7000 BPD | $2,000,000 | Jan. 1957 |
| — | UOP | " | Aromatics (BTX) | 20 MM gal/yr | — | Jan. 1958 |
| | | **Ashland Oil and Refining Company** | | | | |
| Blaw-Knox Co. | Ashland | Canton, Ohio | Vacuum Distillation | 15,000 BPD | — | Oct. 1957 |
| " | Ashland and UOP | " | Platformer | 7000 BPD | $1,900,000 | May 1957 |

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **Atlantic Refining Company** | | | |
| Blaw-Knox Co. | Same and Atlantic | Philadelphia, Pa. | Unifiner and Catformer | 15,000 BPD | — | Mid 1957 |
| " | " | Atreco, Tex. | Unifiner and Catformer | 15,000 BPD | — | " |
| Delta Engineering Corp. | Same and Atlantic | Near Crane, Tex. | Gasoline Absorption | 2800 BPD | — | Sept. 1957 |
| | | | **Aurora Gasoline Company** | | | |
| — | — | Muskegon, Mich. | Expand Vacuum Unit | 6500 BPD | — | End 1956 |
| — | — | " | Fluid Catalytic Cracker | 7000 BPD | — | Early 1957 |
| — | — | " | Catalytic Poly | 1000 BPD | — | Feb. 1957 |
| | | | **Bankline Oil Company** | | | |
| Fluor Corp., Ltd. | Same and Esso | Bakersfield, Calif. | Fluid Coker | 4000 BPD | — | Dec. 1957 |
| | | | **Celanese Corporation of America** | | | |
| — | — | Bishop, Tex. | Formaldehyde, Acetaldehyde, Methanol, etc. | 25% Expansion | — | Late 1957 |
| | | | **Chemoil Corporation** | | | |
| — | — | New Orleans, La. | Refinery | 29,000 BPD | $20,000,000 | 1957 |
| | | | **Cities Service Oil Company (Delaware) and Others** | | | |
| Delta Engineering Co. | — | Roberts Ranch, Midland County, West, Tex. | Natural Gasoline Plant | 50 MMCF/D | — | Mid 1957 |
| | | | **Cities Service Oil Company (Delaware)** | | | |
| Procon, Inc. | UOP | Ponca City, Okla. | Rexformer | 6000 BPD | — | First 1957 |
| Staff | Same | " | Crude Unit Expansion | 12,000 BPD | — | Spring 1957 |
| | | | **Clark Oil and Refining Company** | | | |
| — | — | Chicago, Ill. | Catalytic Cracker | 16,000 BPD | — | Spring 1957 |
| — | — | " | Vacuum Distillation | — | — | — |
| — | — | " | Alkylation | 1600 BPD | — | — |
| | | | **Commerce Oil Refining Company** | | | |
| The Lummus Co. | Same | Providence, R. I. | Refinery | 30,000 BPD | $32,000,000 | 1958 (?) |
| | | | **Commercial Solvents Corporation** | | | |
| Ford, Bacon, and Davis | Same and Staff | Sterlington, La. | Synthetic Methanol Expansion | — | $4,000,000 | July 1957 |
| — | Staff | Terre Haute, Ind. | Expansion | — | $2,000,000 | June 1957 |
| | | | **Commercial Solvents Corporation and Columbia Gas System, Inc.** | | | |
| — | Commercial Solvents | Ohio Valley Area | Ethylene Derivatives | — | $40–50,000,000 | 1958 |
| | | | **Continental Oil Company** | | | |
| — | — | Denver, Colo. | Catalytic Reformer | 3300 BPD | $1,400,000 | Jan. 1958 |
| M. W. Kellogg Co. | Same and Staff | Ponca City, Okla. | Catalytic Reformer | 11,000 BPD | $3,000,000 | Mid 1957 |
| | | | **Cooperative Refinery Association** | | | |
| — | Process Design–UOP | Phillipsburg, Kan. | Unifiner-Platformer | 3500 BPD | $1,500,000 | Sept. 1957 |
| | | | **Cosden Petroleum Corporation** | | | |
| Badger Mfg. Co. | Same | Big Spring, Tex. | Styrene | 20,000,000 lb/yr | $3,000,000 | Late 1957 |
| " | " | " | Unifiner | 2100 BPD | — | — |
| | | | **Delhi-Taylor Oil Corporation** | | | |
| The Refinery Engineering Co. | Same and UOP | Corpus Christi, Tex. | Unifiner-Platformer | 10,500 BPD | — | May 1957 |
| " | " | " | Udex Extraction | 5000 BPD | — | June 1957 |
| | | | **Delta Refining Company** | | | |
| — | — | Memphis, Tenn. | Platformer | 2000 BPD | — | — |
| | | | **Derby Refining Company** | | | |
| J. F. Pritchard | Litwin Engineering | Wichita, Kan. | Crude Expansion | — | — | — |
| " | — | " | Hydrodesulfurizer | 2500 BPD | — | Spring 1957 |
| " | — | " | Ultraformer | 2500 BPD | — | — |
| | | | **Dorchester Corporation** | | | |
| — | Atlantic Refining Co. | White Deer, Tex. | Unifiner-Catformer | 1000 BPD | — | — |
| | | | **Dow Chemical Company (Bay Refining Corp. Division)** | | | |
| — | — | Bay City, Mich. | Ethylene | — | — | Late 1957 |
| | | | **Dow Chemical Company** | | | |
| — | — | Allyn's Point, Conn. | Styron Expansion | — | — | Mid 1957 |
| — | — | Plaquemine, La. | Chemicals | — | $50,000,000 | Spring 1958 |
| — | — | Velasco, Tex. | Chemical Expansion | — | $45,000,000 | Early 1958 |
| Tellepsen Petro-Chemical Construction | Staff and C. F. Braun | " | Synthetic Glycerine Expansion | — | — | Spring 1957 |
| | | | **D-X Sunray Oil Company** | | | |
| The Refinery Engineering Co. | — | Duncan, Okla. | Naphtha Unifiner | 6000 BPD | — | Late 1957 |
| — | — | " | Platformer Expansion | 3500 BPD | — | " |
| The Refinery Engineering Co. | Same and UOP | Tulsa, Okla. | Naphtha Unifiner | 20,000 BPD | | |
| " | " | " | Platformer | 12,000 BPD | | |
| " | " | " | LPG Recovery Unit | 1417 BPD | $10,000,000 | Late 1957 |
| " | " | " | $C_4$ Isomerization | 2453 BPD | | |
| " | " | " | HF Alkylation | 2470 BPD | | |
| | | | **El Paso Natural Gas Products Company** | | | |
| Southwestern Engineering Co. | UOP | Gallup, N. M. | Refinery | 6500 BPD | $8,000,000 | Nov. 1957 |
| | | | **El Paso Natural Gasoline Company and General Tire and Rubber Company** | | | |
| Fluor Corp, Ltd. | Same | Odessa, Texas | GR-S Rubber | 40,000 T/yr | $20,000,000 | July 1957 |
| | | | **Esso Standard Oil Company** | | | |
| — | Esso Research and Engineering Co. | Baton Rouge, La. | Powerformer | 20,000 BPD | — | Mid 1957 |
| — | — | " | Ethylene Unit | — | — | 1957 |

Overall view of the UOP Platforming-Unifining units at the Cheyenne (Wyo.) refinery of Frontier Refining Company.

Unifining unit reactor, with reactor charge heater in background.

Frontier engineer adjusts fuel gas control valve on Platformer charge heater.

# Unifining Cat Cycle Oil Solves Major Sales Problem For Frontier

By M. H. Robineau
President
Frontier Refining Company
Denver, Colo.

A year of steady progress has been experienced by our company since the installation of two new refinery processing units—a UOP Platformer and a Unifining unit.

M. H. Robineau

Before these processes were added, Frontier had a serious sales problem due to the high sulfur content of our cat cycle oil which made it difficult to market profitably our entire daily production of 1,600 barrels of this distillate. We had two markets for this material—Diesel fuel for the Union Pacific Railroad and No. 2 domestic burner oil.

Since the cat cycle oil as such had a sulfur content of 1.25 weight per cent, it failed in its original state to meet the railroad's specifications. Hence we were forced to blend it in equal proportions with a straight run Diesel fuel—for which we had a ready truck market—in order to produce a fuel which met the UP's standards. This operation was economically undesirable because the straight run Diesel which could have been sold for 11 cents a gallon as truck fuel, had to be blended with cycle oil to make a product acceptable to the railroad and for which we received approximately 9 cents a gallon. Compounding the problem was the fact that after selling the maximum possible quantities to the railroad, truck lines and home heating markets, we had remaining several thousand barrels a month of cycle oil which were sold at sacrifice prices as industrial oils because of the high sulfur content.

Another facet of the problem was a short supply of straight run Diesel oil, and there appeared to be little chance that additional amounts could be obtained from the two crude topping units, whose combined daily capacity approximated 10,000 barrels.

Frontier sought the help of Universal Oil Products Company to improve its distillate stock position. UOP, after extensive engineering and pilot plant studies, recommended that we install a Unifining unit to operate alternately on a charge of either 3,000 B/SD of straight run distillate or 2,500 B/SD of a 50-50 blend of cat cycle oil with straight run distillate.

Frontier "bought the idea." However, a major obstacle had to be overcome—a practical source of hydrogen. It was decided to add Platforming not only because it would provide an economical source of hydrogen but because it would also substantially improve the overall octane rating of the refinery's gasoline and would effect considerable savings in the quantities of tetraethyl lead used for motor fuel blending purposes.

The contract for constructing the units was awarded to Procon Incorporated, and work was completed on schedule. With the aid of electronic instrumentation (Frontier is the first U. S. refinery to have liquid level indications completely transmitted by electrical impulses to the graphic panel), the units were lined out in relatively short time. Operation of the Unifining unit differed from the original schemes from the begir.ning. Instead of running on one of the alternate operating plans, cat cycle oil was charged to the unit and it ran on this feed for approximately two months.

Unifining this oil brought notable results. More than 90 per cent of the sulfur was removed, the bromine number was sharply reduced, compatibility was improved, and the cetane number and Diesel index were increased so that more cat cycle oil could be blended off into a higher priced product. The net result was the elimination of a product which formerly was sold at sacrifice prices in favor of one which required no special blending to make it 100 per cent salable.

With the Platformer, Frontier has increased by three numbers the octane ratings of its gasolines while substantially reducing its requirements for tetraethyl lead. The ease of octane improvement inherent to Platforming has made it possible to use natural gasoline, previously employed to upgrade octanes, more profitably elsewhere in the refinery.

The successful operation of the Platforming and Unifining units has given Frontier a new impetus which has been reflected in a more economical refinery operation and a greatly expanded marketing program, the latter by virtue of our ability to offer to the public a variety of products much higher in quality than had been possible previously.

**Frontier combines UOP Platforming and Unifining processes for increased operational economy and expanded marketing program**

designed, engineered and licensed by

**UNIVERSAL OIL PRODUCTS COMPANY**

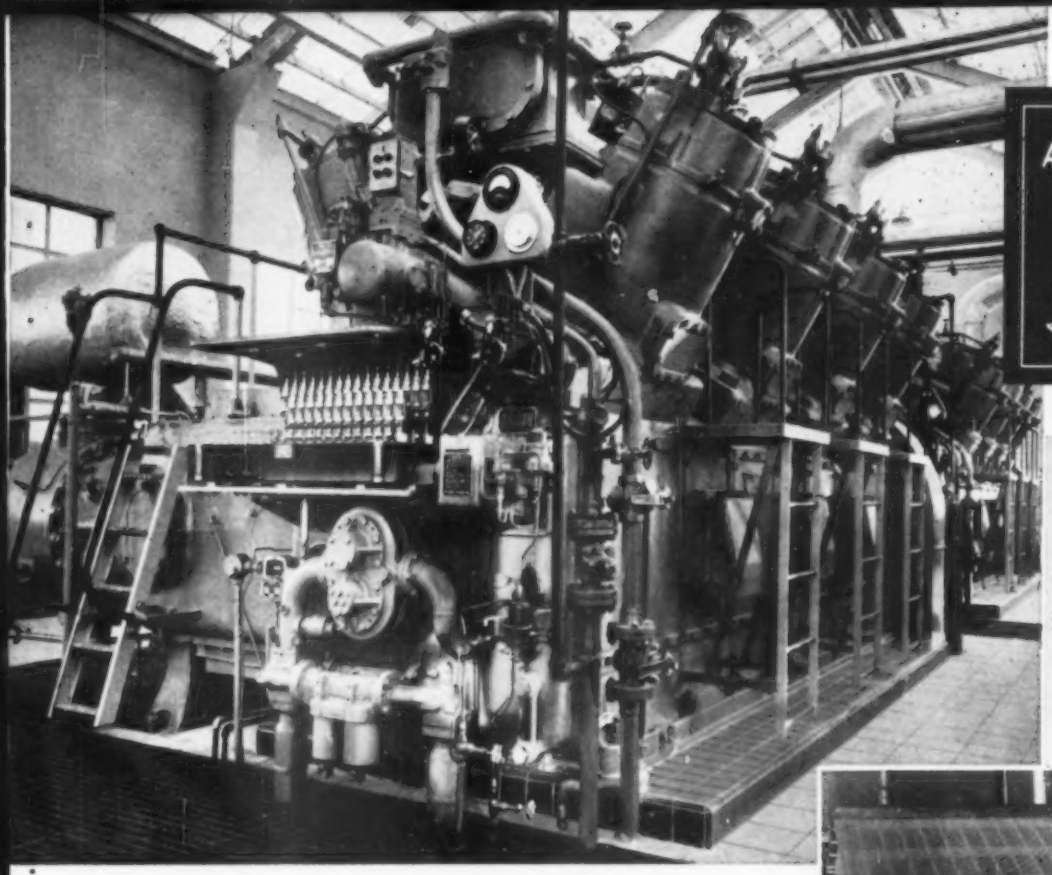
UOP

30 ALGONQUIN ROAD
DES PLAINES, ILL., U.S.A.

*Forty Years Of Leadership In Petroleum Refining Technology*

FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

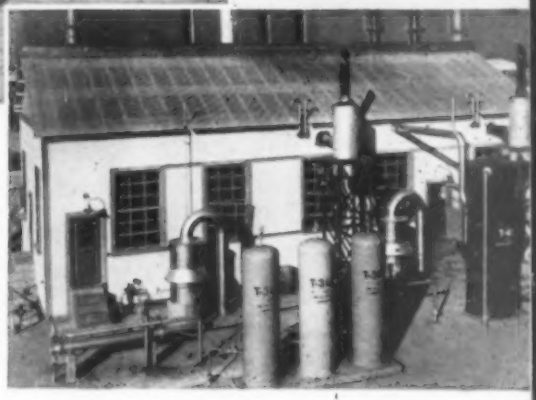
| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| Foster Wheeler Corp. | Esso Research and Engineering Co. | Linden, N. J. | Hydrofiner and Powerformer | 20,000 BPD | — | 1957 |
| Ralph M. Parsons | " | " | $H_2SO_4$ Alkylation | 7500 BPD | — | 1957 |
| Fenix and Scisson | Same and Esso | " | Underground LPG Storage | 300,000 bbl | — | Early 1958 |
| Badger Mfg. Co. | " | Everett, Mass. | Powerformer | 7200 BPD | — | Mid 1957 |
| | | **Ethyl Corporation** | | | | |
| Catalytic Construction Co. | Same | Baton Rouge, La. | Vinyl Chloride | — | — | Late 1957 |
| | | **Firestone Tire And Rubber Company** | | | | |
| Catalytic Construction Co. | Houdry | Orange, Tex. | Butadiene | 40,000 T/yr | — | Early 1957 |
| " | " | " | Styrene | 70,000 T/yr | — | Early 1958 |
| | | **General Aniline And Film Corporation** | | | | |
| Scientific Design Inc. | Same | Linden, N. J. | Ethylene Oxide and Glycol | — | $8,000,000 | 1957 |
| | | **General Petroleum Corporation** | | | | |
| Bechtel Corp. | Same and Socony | Ferndale, Wash. | Sovaformer No. 2 | 9000 BPD | | Sept. 1957 |
| Petroleum Const. Co. | Socony | " | Stove Oil Treater | — | $6,500,000 | Oct. 1956 |
| " | " | " | Jet Fuel Treater | — | | Dec. 1956 |
| — | — | " | Crude Expansion | 13,000 BPD | $7,000,000 | 1958 |
| — | — | Lake Charles, La. | Ammonia | 100,000 T/yr | $12,000,000 | Late 1957 |
| Ralph M. Parsons Co. | Same and Socony | Torrance, Calif. | Sovaformer and Expanded Gasoline Facilities | 12,000 BPD | $8,000,000 | Sept. 1957 |
| | | **General Rubber Synthetics Company** | | | | |
| H. K. Ferguson Co. | General Tire | Odessa, Tex. | Synthetic Rubber | 40,000 LT/yr | $10,000,000 | July 1957 |
| | | **B. F. Goodrich Chemical Company** | | | | |
| Girdler Co. | Same | Avon Lake, Ohio | Polyvinyl Resin | — | $5,000,000 | March 1957 |
| Wigton-Abbott Corp. | — | Calvert City, Ky. | Acrylic Polymers | — | — | Oct. 1957 |
| | | **Goodrich-Gulf Chemicals, Inc.** | | | | |
| Girdler Co. | Same | Institute, W. Va. | Boiler House | 100,000 lb/hr | $1,500,000 | — |
| — | — | " | Rubber Plant Modernization | — | — | 1957 |
| | | **Goodyear Synthetic Rubber Corporation** | | | | |
| — | Karglien and Hughes; Goodyear | Akron, Ohio | GR-S Latex | — | $2,400,000 | May 1957 |
| | | **Grace Chemical Company** | | | | |
| Fluor Corp., Ltd. | — | Baton Rouge, La. | Polyethylene | 25,000 T/yr | $18,000,000 | Mid 1957 |
| | | **Gulf Natural Gasoline Corporation** | | | | |
| Delta Engineering Co. | Same | Caddo Parish, La. | Gasoline Plant | 20,000,000 CF/D | — | Spring 1957 |
| | | **Gulf Oil Corporation** | | | | |
| M. W. Kellogg Co. | Same and Gulf | Philadelphia, Pa. | Gulfining Units (2) | 20,000 BPD each | — | Early 1957 |
| Ralph M. Parsons Co. | Same | " | $H_2SO_4$ Alkylation | 3000 BPD | — | Mid 1957 |
| Procon, Inc. | Same and UOP | " | Platformers (2) | 26,000 BPD each | — | Late 1957 |
| " | " | " | Cooling Tower | "Doubled" | — | " |
| " | " | " | Steam Unit | 400,000 lb/yr | — | " |
| " | " | " | Tankage | 1,000,000 bbl | — | " |
| Staff | Same | " | LPG Storage | 300,000 gal | — | Early 1957 |
| Ralph M. Parsons, Leonard Construction Co. | — | Port Arthur, Tex. | $H_2SO_4$ Recovery | 160 T/D | — | Early 1957 |
| Procon, Inc. | Same and UOP | " | Mod. Cat Poly | 2900 BPD | — | Mid 1957 |
| " | " | " | Platformer | 26,000 BPD | — | Early 1958 |
| " | " | " | Hydrobon Unit (addition to Platformer | 29,000 BPD | — | " |
| Ralph M. Parsons Co. | Same | " | Sulfur Recovery | 60 T/D | — | Early 1957 |
| Summer Sollitt Co. | Same | " | Grease Mfg. and Packaging | — | — | Late 1957 |
| | | **Hancock Oil Company** | | | | |
| Ralph M. Parsons Co. | Same and Esso | Signal Hill, Calif. | Fluid Coker | 6000 BPD | $2,000,000 | Mid 1957 |
| | | **Hercules Powder Company** | | | | |
| — | — | Parlin, N. J. | Polyethylene | 15,000 T/yr | $10,000,000 | 1957 |
| Vulcan C. & S. Co. | Same | Louisiana, Mo. | Methanol | 7,000,000 gal/yr | $2,000,000 | Mid 1957 |
| | | **Honolulu Oil Company (19 Others)** | | | | |
| — | — | Prentice Field, Yoakum County, Tex. | Natural Gasoline Plant | 12MMCF/D | — | Early 1957 |
| | | **Humble Oil And Refining Company** | | | | |
| Foster Wheeler Corp. | Same and Humble | Baytown, Texas | Catalytic Cracker | 55,000 BPD | $27,000,000 | 1957 |
| — | Humble | " | Benzene Plant | 24,000,000 gal/yr | — | Late 1957 |
| | | **International Refineries, Inc.** | | | | |
| — | Esso Research and Engineering Co. | Wrenshall, Minn. | Powerformer | 3000 BPD | — | Mid 1957 |
| | | **Jones And Laughlin Steel Corporation** | | | | |
| Badger Mfg. Co. | Same | Aliquippa, Pa. | Hydrofiner | — | $2,000,000 | Early 1957 |
| | | **Kendall Refining Company** | | | | |
| Staff | UOP | Bradford, Pa. | Unifiner-Platformer Revanys | 2000 BPD | $300,000 | Mid 1957 |
| | | **Kerr-McGee Oil Industries, Inc.** | | | | |
| C. F. Braun Co. | Same | Cushing, Okla. | Modernization | — | — | — |
| | | **Koppers-Brea Chemicals, Inc.** | | | | |
| Koppers Construction Div. | Same | Los Angeles, Calif. | Polyethylene | 60,000,000 lb/yr | $10,000,000 | Mid 1957 |



*Another example of efficient compression at lower cost*

Petroleos Mexicanos' Reynosa station, showing 8-cylinder Cooper-Bessemer V-angle compressors.

Exterior view of the neat, compact Reynosa gasoline plant.



# COOPER-BESSEMER COMPRESSORS

## FOR PETROLEOS MEXICANOS

*. . . extreme dependability*
*. . . extremely economical*

● The compression of natural gas and propane in Petroleos Mexicanos' gasoline plant, Reynosa, Tamps., Mexico, is a perfect example of extremes . . . all good!

Handling three pressure ranges, and handling them reliably and at low cost, is a brief summation of the Cooper-Bessemer performance story in this modern station.

Two 8-cylinder Cooper-Bessemer compressors handle plant process gas as well as compressing gas for distribution in northeast areas of Mexico and for export.

Known not only for performance . . . the name Cooper-Bessemer means cooperation and service all along the line. Detailed installation recommendations, experienced service engineers, availability and rapid delivery of spare parts from centrally located warehouses . . . each helps make your job easier, helps keep costs at a minimum. Find out for yourself, next time plans call for compressors up to 6,000 hp, check with Cooper-Bessemer.

ENGINES: GAS • DIESEL • GAS-DIESEL COMPRESSORS: RECIPROCATING AND CENTRIFUGAL, ENGINE OR MOTOR DRIVEN

**cooper-bessemer**

MOUNT VERNON, OHIO • GROVE CITY, PENNA.

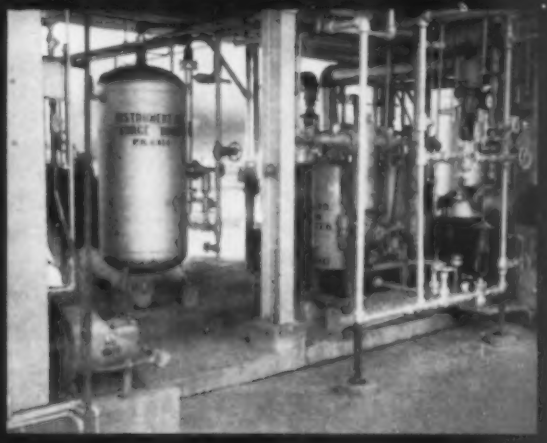
Branches in principal U. S. Cities, also: Edmonton and Calgary, Alberta • Halifax, N. S. • Caracas, Venezuela • Mexico City, Mex.

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **Leonard Refineries, Incorporated** | | | |
| Staff | Staff | Alma, Michigan | Crude Expansion | 4000 BPD | $150,000 | June 1957 |
| | | | **Lion Oil Company** | | | |
| Chemical & Industrial Constr. Co. | Same | El Dorado, Ark. | Nitric Acid Concentrator Plant | 40 T/D | — | March 1957 |
| | | | **Magnolia Petroleum Company** | | | |
| Bechtel Corp. | Socony-Mobil | Beaumont, Tex. | TCC Unit | 27,800 BPD | — | Early 1957 |
| — | — | " | Sovafiner | 30,000 BPD | — | Late 1957 |
| — | — | " | $H_2SO_4$ Alkylation | 6000 BPD | — | " |
| | | | **New England Industries, Inc.** | | | |
| — | — | Bellingham, Wash. | Refinery | — | $18,000,000 | 1957 |
| | | | **Northwestern Refining Company** | | | |
| — | — | St. Paul Park, Minn. | Catalytic Reformer | 5000 BPD | — | Early 1957 |
| | | | **Odessa Butadiene Company** | | | |
| Fluor Corp., Ltd. | — | Odessa, Texas | Butadiene | 50,000 T/yr | $22,000,000 | July 1957 |
| | | | **Odessa Styrene Company** | | | |
| Fish Engineering Corp. | UOP | Odessa, Tex. | Styrene Plant | 35,000,000 lb/yr | $5,000,000 | Jan. 1958 |
| | | | **Pan-Am Southern Corporation** | | | |
| — | — | Destrehan, La. | Polybutene | 250 BPD | — | — |
| The Lummus Co. | Same and Staff | El Dorado, Ark. | Ultraformer | 6200 BPD | — | Mid 1957 |
| | | | **Petroleum Chemicals, Inc.** | | | |
| Fluor Corp. Ltd. | Same | Lake Charles, La. | Coker | 10,000 BPD | $6,250,000 | 1957 |
| — | — | " | Ammonia Unit | 300 T/D | $1,250,000 | Fall 1957 |
| The Lummus Co. | Same | " | Ethylene Extraction | 100,000 T/yr | — | Jan. 1958 |
| | | | **Phillips Chemical Company** | | | |
| — | — | Borger, Tex. | Butadiene Expansion | 24,000 T/yr | — | Mid 1957 |
| — | — | " | Synthetic Rubber | 30,000 T/yr | — | " |
| Farnsworth and Chambers | Staff | Houston, Tex. | Polyethylene Plant | 110,000 lb/yr | — | Late 1957 |
| Badger Div. | Same | Sweeny, Tex. | Ethylene | 165 T/D | $12,000,000 | Spring 1957 |
| " | " | " | Butadiene | 90 T/D | — | Mid 1957 |
| | | | **Phillips Petroleum Company** | | | |
| Procon, Inc. | Same and Phillips | Great Falls, Mont. | Catalytic Cracking Unit | 3000 BPD | — | Spring 1957 |
| — | — | Kansas City, Kan. | Isomerization Unit | — | $6,000,000 | 1957 |
| | | | **Pontiac Eastern Refining Company** | | | |
| — | — | Hattiesburg, Miss. | Refinery | 15,000 BPD | — | Spring 1957 |
| | | | **Premier Oil Refining Company Of Texas** | | | |
| Procon, Inc. | UOP and Procon | Greggton, Tex. | Unifiner-Platformer | 1500 BPD | $1,250,000 | April 1957 |
| | | | **Pure Oil Company** | | | |
| M. W. Kellogg Co. | Same | Lemont, Ill. | Catalytic Reformer | 12,000 BPD | — | End 1957 |
| " | " | " | Feed Preparation Unit | 17,000 BPD | — | End 1957 |
| — | — | Nederland, Tex. | Salt-Cavity Storage | 200,000 bbl | — | Jan. 1957 |
| | | | **Rohm & Haas** | | | |
| Foster Wheeler Corp. | Same | Houston Tex. | Methanol | 100 T/D | — | Early 1957 |
| | | | **Rothschild Oil Company** | | | |
| C. F. Braun Co. | Same | Santa Fe Springs, Calif. | Catalytic Cracker | 6000 BPD | $2,000,000 | Early 1957 |
| | | | **Salt Lake Refining Company** | | | |
| Fluor Corp., Ltd. | Same and Salt Lake | Salt Lake City, Utah | Catalytic Reformer | 6000 BPD | — | Nov. 1957 |
| The Refinery Engineering Co. | Same | Westville, N. J. | Hydrotreater | 6500 BPD | — | Early 1957 |
| | | | Visbreaker | 13,330 BPD | — | " |
| | | | **Shell Chemical Corporation** | | | |
| Fluor Corp., Ltd. and C. F. Braun Co. | Same | Norco, La. | Hydrogen Peroxide | — | — | Spring 1957 |
| Fluor Corp., Ltd. | Same and Staff | " | MEK Unit | 40,000,000 lb/yr | — | 1957 |
| Ralph M. Parsons Co. | Same | Torrance, Calif. | Cold High Solids, Latex | — | — | Late 1957 |
| | | | **Shell Oil Company** | | | |
| — | — | Martinez, Calif. | Asphalt Plant | 1500 BPD | — | March 1957 |
| | | | **Sinclair Refining Company** | 2000 BPD | | |
| — | Sinclair | Wood River, Ill. | Catalytic Reformer | 7500 BPD | — | Mid 1957 |
| | | | **Sinclair Research Laboratories, Inc.** | | | |
| D. J. Dengenhart Co. | Staff | Harvey, Ill. | Atomic Radiation Lab | — | $500,000 | Early 1957 |
| | | | **Socony Mobil Company, Inc.** | | | |
| Foster Wheeler Corp. | Same | Paulsboro, N. J. | Hydrodesulfurizer | 22,000 BPD | $3,400,000 | Early 1957 |
| | | | **Southland Oil Company** | | | |
| — | — | Tampa, Fla. | Refinery: Crude Distillation, Catalytic Cracker, Catalytic Reformer Alkylation, Light Ends, etc. | 15,000 BPD | $10,000,000 | 1957 |
| | | | **Standard Oil Company Of California** | | | |
| Fluor Corp., Ltd. | Same | El Segundo, Calif. | Crude Handling Facilities | — | $3,000,000 | — |
| " | " | " | Residuum Stripper | 25,200 BPD | $3,000,000 | April 1957 |
| | | | **Standard Oil Company (Indiana)** | | | |
| Foster Wheeler Corp. | Same | Casper, Wyo. | Lube Plant | | — | Mid 1957 |
| | | | Vacuum Distillation | 5000 BPD | | |
| | | | Furfural Unit | 1500 BPD | | |
| | | | Dewaxing, Deoiling | 2000 BPD | | |
| | | | Propane Deasphalting | 1000 BPD | | |
| " | Same & Staff | Neodesha, Kan. | Ultraformer | 6000 BPD | — | Late 1957 |

Branches in principal U.S. cities, also: Edmonton and Calgary, Alberta • Halifax, N.S. • Caracas, Venezuela • Mexico City, Mex.

# Indoor security for outdoor equipment

Compressor house at Standard Oil Company's new Ultraformer, Cleveland, Ohio.



This Type BY Lectrodryer* dries 80 cfm. of compressed air to a dewpoint of -20° F.

Freezing weather and high humidity won't bother this open-air equipment and the refinery it serves. It's proof against the elements. Consider the instrument air, for example—

This compressed air passes through the Lectrodryer—is dried DRY. No freezeups. No moisture to form mud or rust to clog tiny instrument ports.

Bulletin 223-B will tell you about this DRYing help. For a copy, write Pittsburgh Lectrodryer Company, 334 32nd Street, Pittsburgh 30, Pennsylvania. (a McGraw Electric Company division)

# Lectrodryer

*REGISTERED TRADEMARK U. S. PAT. OFF.

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| — | Staff and Sumner Sollitt Co. | Whiting, Ind. | Research Laboratories | 58,000 sq ft | $8,000,000 | — |
| — | — | " | Urea Lube Dewaxing | 10,000,000 gal/yr | — | 1957 |
| — | — | Spring Creek, Mo. | Alkylation | 4000 BPD | — | Spring 1957 |
| | | **Socony Mobil Oil Company, Inc.** | | | | |
| — | — | East St. Louis, Mo. | Sovafiner | 16,000 BPD | — | Early 1957 |
| — | — | " | Sovaformer | 12,000 BPD | $4,750,000 | " |
| — | — | Trenton, Mich. | Sovaformer | 9000 BPD | $2,500,000 | — |
| | | **Standard Oil Company (Ohio)** | | | | |
| M. W. Kellogg Co. | Same | Toledo, Ohio | Modernization and Crude Expansion Including: Atmospheric and Vacuum Distillation; Delayed Coking; Catalytic Cracking; Hydrogenation; Cat Polymerization; Cat Reforming; Alkylation, Recovery, Treating; Gasoline Blending; Steam Generation. | 60,000 BPD | $35-40,000,000 | 1957-58 |
| | | **Standard Oil Company Of Texas** | | | | |
| Fluor Corp. Ltd. | Same | El Paso, Tex. | Model IV-Catalytic Cracker and Recovery Fac. | 27,000 BPD | $5,000,000 | Sept. 1957 |
| | | **Stauffer Chemical Company** | | | | |
| Stauffer Research Dept. and Singmaster and Bryer | Ralph M. Parsons | Louisville, Ky. | Carbontetrachloride | — | — | June 1957 |
| " | " | " | Perchlorethylene | — | — | " |
| " | " | " | Chloroform | — | — | " |
| " | " | " | Methychloride | — | — | " |
| " | " | " | Hydrogenchloride | — | — | " |
| | | **Straits Refining Company** | | | | |
| — | — | Tacoma, Wash., Area | Refinery | 10,000 BPD | $26,400,000 | 1957 |
| | | **Sun Oil Company** | | | | |
| Nason & Cullen | Sun Oil Co. | Marcus Hook, Pa. | Research and Development Laboratory | — | $1,000,000 | April 1957 |
| | | **Sunray Mid-Continent Oil Company** | | | | |
| Tuloma Builders | Same and Staff | Carney, Okla. | Gas Products Plant | 17,500,000 CF/D | — | March 1957 |
| — | — | Keatchie, La. | Gas Products Plant | 40,000,000 CF/D | — | Aug. 1957 |
| | | **Suntide Refining Company** | | | | |
| Suntide Refining Co. | Same | Corpus Christi, Tex. | Cat Cracker Expansion | 25,000 BPD | $300,000 | March 1957 |
| Hudson Engineering | Same | " | Cooling Tower | 30,000 GPM | $150,000 | " |
| Vogt Co. | Same | " | 2 Boilers | 75,000 lb/hr each | $250,000 | " |
| Refinery Engineering Co. | UOP | " | Unifiner | 6000 BPD | $5,000,000 | May 1957 |
| " | " | " | Rexformer | 15,000 BPD | | " |
| " | " | " | Udex Extraction | 7500 BPD | | " |
| " | " | " | HF Alkylation | 1000 BPD | | " |
| Suntide Refining Co. | Same | " | Miscellaneous Piping | — | $500,000 | " |
| GATX | Same | " | Tankage | 500,000 bbl | $2,250,000 | Jan. 1958 |
| | | **Texas Butadiene & Chemical Corporation** | | | | |
| Fluor Corp., Ltd. | Same | Houston, Tex. | Butadiene | 60,000 T/yr | $26,000,000 | Early 1957 |
| | | | Aviation Gasoline | 2.5 MMbbl/yr | — | — |
| | | **Texas City Refining Company** | | | | |
| Catalytic Construction Co. | Houdry | Texas City, Tex. | Houdriformer | 7000 BPD | $2,000,000 | Sept. 1957 |
| | | **The Texas Company** | | | | |
| Fluor Corp., Ltd. | Same | Port Arthur, Tex. | Vacuum Pipe Still | 80,000 BPD | — | Dec. 1957 |
| M .W. Kellogg Co. | Same | " | Catalytic Cracker | 90,000 BPD | — | " |
| The Texas Co. and Others | The Texas Co. | " | Increase Alky. Cap. | 2000 BPD | — | " |
| Staff | UOP | Lockport, Ill. | Convert Hydroformer to Platformer | 10,000 BPD | — | " |
| The Texas Co. and Others | Jackson and Moreland | Port Arthur, Tex. | Power Plant | 900,000 lb/hr Steam and 15,000 KWH | — | " |
| Foster Wheeler Corp. | Same and Chemical and Ind. Corp. | " | Ammonia and Derivatives | 180 T/D | — | " |
| The Refinery Engineering Co. | Same | Westville, N. J. | Hydrotreater | 6500 BPD | — | Early 1957 |
| | | | Visbreaker | 13,300 BPD | — | " |
| | | **Texas-U. S. Chemical Company** | | | | |
| — | — | Port Neches, Tex. | Butadiene Expansion | To 300,000 ST/D | — | — |
| | | **Tidewater Oil Company** | | | | |
| Bechtel Corp. | Same and Esso | Associated, Calif. | Fluid Coker | 42,000 BPD | — | Early 1957 |
| O. L. Olsen Co. | Same | New Hope Field | Low-Temp Separation Unit | 750 BPD | $1,000,000 | May 1957 |
| C. F. Braun Co. | — | Wilmington, Del. | Refinery | 130,000 BPD | $130,000,000 | Early 1957 |
| | | **Union Oil And Gas Corporation** | | | | |
| Fluor Corp., Ltd. | Same | Eunice, La. | Natural Gasoline Plant | 300,000,000 CF/D | — | June 1957 |
| | | **Union Oil Company** | | | | |
| — | — | Los Angeles, Calif. | Ethylene | 100 MMlb/yr | — | End 1957 |
| | | **United Refining Company** | | | | |
| Procon, Inc. | UOP | Warren, Pa. | Fluid Catalytic Cracker | 2500 BPD | $2,000,000 | March 1957 |
| " | " | " | Catalytic Poly Unit | 250 BPD | | " |
| " | " | " | Treater | — | | " |

# Inside Story on POWELL STEEL VALVES

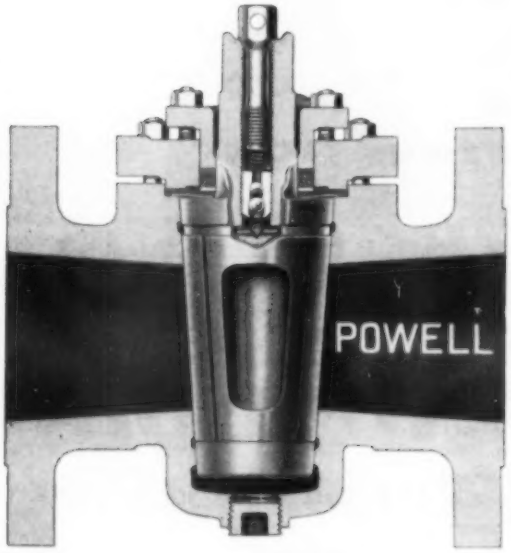



FIG. 3059--(Sectional)--A.S.A. 300-pound Steel Lubricated Plug Valve.

FIG. 2456 SS--OS&Y Gate Valve--1/16 Raised Face Separate Yoke Arms. Flanges are in accordance with ASA B16.5.

Steel Valves may appear similar on the outside. But their performance may be quite another story--for there can be a big difference in the metal, in design and in manufacture. And the inside story on Powell Steel Valves is that every valve has PERFORMANCE VERIFIED.

Only the finest materials are used in Powell Steel Valves. And painstaking quality control is rigidly enforced through each step of manufacture. For example, every machining operation is accurately gauged. All parts are thoroughly cleaned and degreased. As a final step in manufacture, EVERY POWELL STEEL VALVE IS GIVEN AN ACTUAL LINE TEST.

Because of Powell's painstaking quality control, plant shutdown through valve failure is practically unknown. Records from refineries, power and industrial plants the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE quality line which has PERFORMANCE VERIFIED.

Fig. 2433 SS--Stainless Steel Bolted Cap Swing Check Valve for 150 pounds W.P.

PERFORMANCE PV VERIFIED

**The Wm. Powell Company, Cincinnati 22, Ohio . . . 111th YEAR**

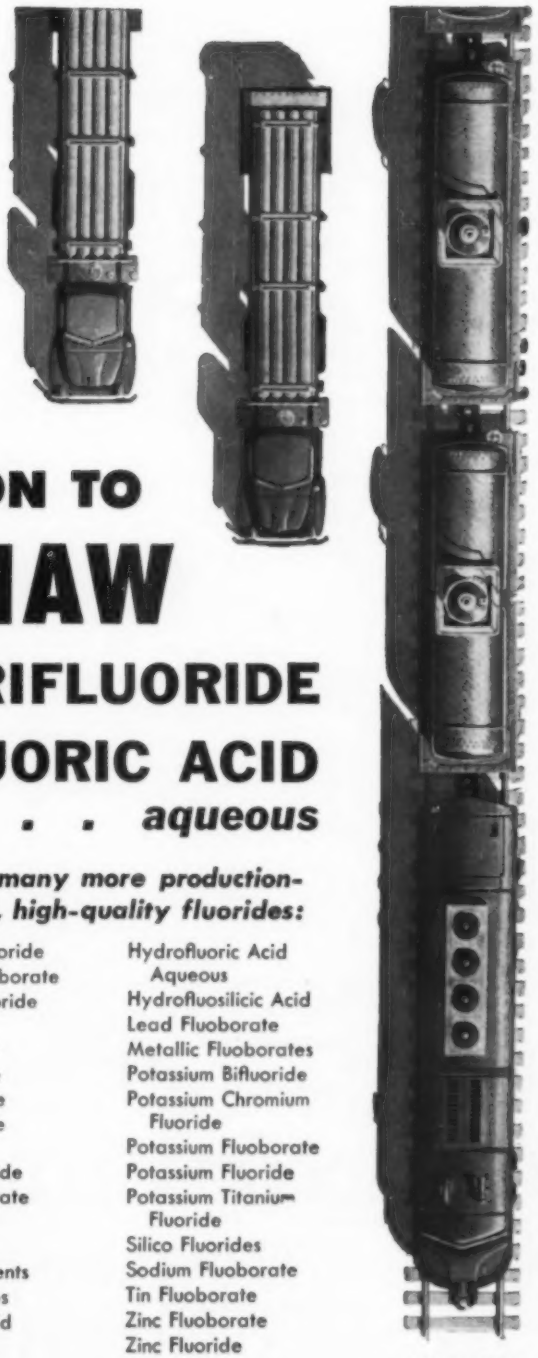
# POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **United States Rubber Company** | | | |
| Walter Kidde Constructors, Inc. | — | Baton Rouge, La. | Petrochemicals | 60,000,000 lb/yr | $5,000,000 | End 1957 |
| " | — | " | Pipe Plastics | — | — | " |
| | | | **Vickers Petroleum Company** | | | |
| Ralph M. Parsons Co. | Litwin Engineering Co. | Potwin, Kan. | Ultraformer | 3500 BPD | — | Mid 1957 |
| Owner | Socony-Mobil | " | Catalytic Cracker Expansion | — | $250,000 | Jan. 1957 |

# FOREIGN CONSTRUCTION

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **Alba** | | | |
| — | — | Cubatao, Brazil | Methanol | — | $3,500,000 | 1958 |
| — | — | " | Formaldehyde | — | | |
| — | — | " | Synthetic Resins | — | | |
| | | | **The Air Liquide Company of Paris** | | | |
| — | — | Takoradi, Africa | Oxygen and Acetylene Production | — | — | — |
| | | | **Antar-Petroles l'Atlantiqud** | | | |
| Hydrocarbon Research, Inc. | Houdry | Donges, France | Houdriformer and Udex | 13,000 BPD | $10,000,000 | March 1957 |
| | | | **Arabian American Oil Company** | | | |
| Lummus Co., Ltd. | Same | Ras Tanura, S. Arabia | Hydrofiner | 15,000 BPD | $4,000,000 | Early 1957 |
| | | | **Bahrain Petroleum Company** | | | |
| Foster Wheeler Corp. | Same | Bahrain, Persian Gulf | Platformer | 10,000 BPD | — | Early 1957 |
| | | | **Berry Wiggins & Company, Ltd.** | | | |
| Head Wrightson Processes, Ltd. | Same | (Weaste) Manchester, England | Refinery Expansion | 500 BPD | — | — |
| " | " | " | Distillation Unit | 250 T/D | — | 1957 |
| | | | **Bitumens and Oil Refineries, Ltd.** | | | |
| — | — | Queensland, Australia | Platformer | 1500 BPD | — | 1957 |
| — | — | " | Crude Unit | 5000 BPD | — | " |
| — | — | " | Desulfurization | 1500 BPD | — | " |
| | | | **British American Oil Company, Ltd.** | | | |
| M. W. Kellogg Co. | Same | Clarkson, Ontario, Canada | Crude Expansion | 40,000 BPD | $6,500,000 | Late 1958 |
| Lummus Co., Ltd. | — | " | Catalytic Reformer | 10,000 BPD | | April 1957 |
| M. W. Kellogg Co. | — | " | Crude and Vacuum Distillation | 40,000 BPD | | Sept. 1957 |
| Lummus Co., Ltd. | — | " | Desulfurization | 16,000 BPD | $750,000 | June 1957 |
| Babcock and Wilcox | — | " | C. O. Boiler | 150,000 lb/hr | $600,000 | Early 1957 |
| Fluor Corp., Ltd. | — | " | Offsites | — | $7,500,000 | Late 1957 |
| Lummus Co., Ltd. | — | Montreal E., P. Q., Canada | Cat. Desulfurization | 15,500 BPD | $1,000,000 | Early 1957 |
| | | | **British Hydrocarbon Chemicals, Ltd.** | | | |
| — | — | Grangemouth, Scotland | Polyethylene | 25,000,000 lb/yr | — | — |
| | | | **British Petroleum Company** | | | |
| Middle East and Bechtel Corp. and Geo. Wimpey and Co., Inc. | M. W. Kellogg | Aden, Arabia | Thermal Reformer | 12,000 BPD | $1,400,000 | Early 1958 |
| Richard Costain, Ltd. | — | Sunbury, England | Analytical and Physics Lab. | — | $1,200,000 | Early 1958 |
| " | — | " | Prod. Research Lab. | — | — | End 1957 |
| Local Contractors | — | Hamburg, Germany | Increasing Capacity | 33-40,000 BPD | — | End 1957 |
| Geo. Wimpey and Co. and Sir Robt. McAlpine and Sons | E. B. Badger and Sons, Kellogg International Corp. (with Universal Oil Products Co.) Power Gas Corp., W. J. Fraser and Co., Rendel, Palmer and Tritton | Isle of Grain, Kent, England | Distillation Unit | 90,000 BPD | $26,000,000 | — |
| | | | Catalytic Reformer | 8-10,000 BPD | | |
| | | | Thermal Reformer | 10,000 BPD | | |
| | | | Hydrofiners (2) | 10,000 BPDeach | | |
| | | | Stabilizers | 12,000 BPD | | |
| | | | Solutizers (2) | 2000 BPD each | | |
| | | | Copper Chloride Units(2) | 8000 BPD each | | |
| | | | Alkylation Unit | 2250 BPD | | |
| Head Wrightson Processes, Ltd. | Same | Cardon, Venezuela | Gas Plant | 1900 Tons (Liquid Feed) | — | — |
| " | " | Curacao, Venezuela | Gas Plant | 1900 Tons (Liquid Feed) | — | — |
| " | " | " | Gas Plant | 654 Tons (Gas Feed) | — | — |
| " | " | Pernis, Holland | Gas Plant | 1900 Tons (Liquid Feed) | — | — |
| " | " | " | Gas Plant | 654 Tons (Gas Feed) | — | — |



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## HYDROFLUORIC ACID

***anhydrous . . . aqueous***

***Here are many more production-controlled, high-quality fluorides:***

- Ammonium Bifluoride
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- Bismuth Fluoride
- Boron Trifluoride
- Boron Trifluoride Complexes
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- Hydrofluoric Acid Aqueous
- Hydrofluosilicic Acid
- Lead Fluoborate
- Metallic Fluoborates
- Potassium Bifluoride
- Potassium Chromium Fluoride
- Potassium Fluoborate
- Potassium Fluoride
- Potassium Titanium Fluoride
- Silico Fluorides
- Sodium Fluoborate
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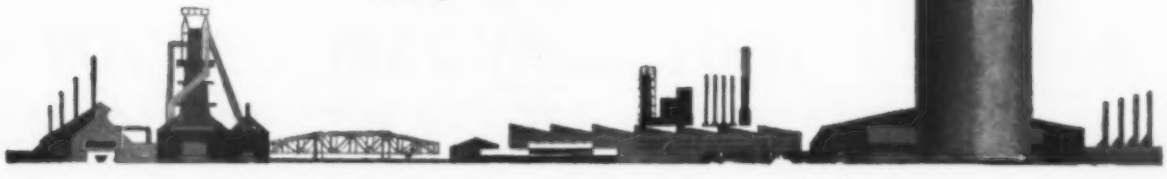
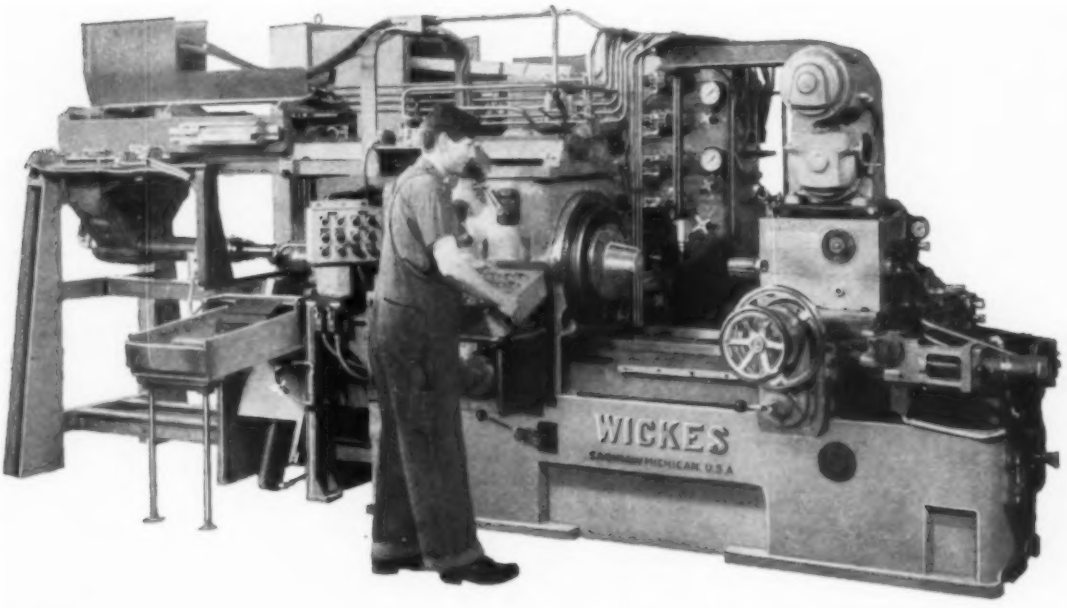


| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **British Petroleum Company and Petrofina** | | | |
| — | — | Antwerp, Belgium | Hydrofiner | 8000 BPD | — | — |
| — | — | " | Catalytic Reformer | 7000 BPD | — | — |
| | | | **Caltex, S. A. F.** | | | |
| Lummus Co., Ltd. | Same | Ambes, France | Catalytic Cracker | 4700 BPD | — | 1957 |
| " | " | " | Vacuum Unit | 6600 BPD | — | " |
| " | Foster Wheeler | " | Poly Plant | 440 BPD | — | " |
| | | | **Caltex Petroleum Maat.** | | | |
| Lummus Co., Ltd. | Same | Pernis, Holland | Platformer | 7000 BPD | — | 1957 |
| " | " | " | Desulfurization | 4000 BPD | — | " |
| | | | **Caltex Oil Refinery, Ltd.** | | | |
| Lummus Co., Ltd. | Same and Staff | Visakhapatnam, India | Refinery | 13,500 BPD | — | Early 1957 |
| | | | **Canadian Oil Companies, Ltd.** | | | |
| Fluor Corp., Ltd. | Universal Oil Prod. Co. | Sarnia, Ontario, Canada | Petrochemical Plant | — | | |
| " | " | " | Udex Plant | 3650 BPD | $3,000,000 | Mid 1957 |
| " | " | " | Platforming Unit | 4400 BPD | | |
| | | | **Canadian Southern Oils** | | | |
| — | — | Saskatchewan, Canada | Refinery | 10–20,000 BPD | $7-10,000,000 | — |
| | | | **Chemische Werke Huls, A. G.** | | | |
| Firma Still, Recklinghausen | Houdry Process Corp. | Marl, Kreis Reckling-hausen, W. Germany | Dehydrogenation (Butadiene) | 40,000 T/yr | $24,000,000 | — |
| — | — | West Germany | Synthetic Rubber | 30,000 T/yr | | |
| | | | **Cie Francaise de Raffinage** | | | |
| — | Esso Research and Engineering Co. | La Mede, France | Powerformer | 20,000 BPD | — | 1958 |
| | | | **Colombian Petroleum Company** | | | |
| — | — | Colombia | Gas Processing Unit | — | $5,000,000 | — |
| | | | **Commonwealth Oil Refining Company, Inc.** | | | |
| Lummus Co., Ltd. | Houdry Process Corp. | Guayanilla Bay, Puerto Rico | Plant Expansion, Crude Combination Unit; Houdry Cracking Plant; Houdry Reforming Unit; Calif. Type Poly Plant; $SO_2$ Treating Plant | 25–55,000 BPD | $40,000,000 | Mid 1957 |
| | | | **Creole Petroleum Corporation** | | | |
| Foster Wheeler Corp. | Same | Amuay Bay, Venezuela | Pipe Still | 70,000 BPD | $10,800,000 | — |
| | | | **Daiko Oil Company** | | | |
| The Refinery Engineering Co. | Houdry | Yokkaichi, Japan | Houdriformer | 3000 BPD | — | Mid 1957 |
| | | | **Deutsche Shell A. G.** | | | |
| Edeleanu-Gesellschaft m. b. H. | Lummus Nederland N. V. | Hamburg, Germany | Platformer and Hydro-desulfurizer | 20,000 BPD | — | Mid 1957 |
| | | | **Deutsche Vacuum Oil Company** | | | |
| — | — | Brenen-Oslebshausen | Sovaformer | 3200 BPD | — | 1957 |
| | | | Sovafiner | 4800 BPD | — | " |
| | | | **Dow Chemical Company** | | | |
| Bechtel Corp. | Same | Bombay, India | Polystyrene Plant | 3000 T/yr | — | — |
| | | | **Egyptian Government** | | | |
| — | — | Assuan Dam, Egypt | Ammonia Plant | 1200 T/D | — | — |
| | | | **Enici** | | | |
| Brown and Root | Union Carbide and Carbon | Ravenna, Italy | Butadiene, etc. | 30,000 T/yr (copolymer) | $75,000,000 | Mid 1957 |
| | | | **Esso Petroleum Company, Ltd.—Shellmex—British Petroleum—Caltex** | | | |
| — | — | Whitegate, Ireland | Refinery | 11,200,000 B/yr | $25,000,000 | Late 1959 |
| | | | **Esso Italiana** | | | |
| — | Esso Research and Engineering Co. | Trieste, Italy | Powerformer | 1000 BPD | — | 1957 |
| | | | **Esso Standard Refinery, S. A.** | | | |
| — | Esso Research and Engineering Co. | Antwerp, Belgium | Cyclic Powerformer | 5600 BPD | — | 1958 |
| | | | **Esso A. G.** | | | |
| — | Esso Research and Engineering Co. | Cologne, Germany | Cyclic Powerformer | 9000 BPD | — | 1959 |
| | | | **Esso Petroleum Company, Ltd.** | | | |
| — | — | Fawley, England | Crude Oil Distillation | 70,000 BPD | $36,400,000 | Dec. 1958 |
| — | — | " | Auto Diesel Hydro-finers (2) | — | — | — |
| — | — | " | Jetty Berth | — | — | — |
| — | — | " | Separator Plant | — | — | — |
| — | — | " | Sulfur Recovery Plant | 2800 T/yr | — | — |
| | | | **Esso Standard Oil Company, S. A. (Cuba)** | | | |
| A. G. McKee Co. | Esso Research and Engineering Co. | Belot, Cuba | Hydrofining, Power-forming, Catalytic Cracking, Catalytic Poly Units | 35,000 BPD Crude Capacity | $30,000,000 | 1957 |

# THE NEW WICKES NO. 18 COMPLETELY AUTOMATIC SMALLEY-GENERAL TOOL-JOINT THREAD MILLER




AUTOMATICALLY **LOADS** · AUTOMATICALLY **CHUCKS** · AUTOMATICALLY **MACHINES AND** AUTOMATICALLY **UNLOADS** ALL SIZES ROTARY TOOL JOINTS (BOXES, PINS)

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**THE WICKES CORPORATION • SAGINAW, MICHIGAN**

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# How to run a gasoline plant without WATER

The new Adena plant near Fort Morgan, Colorado, was designed for unusual climatic and operating conditions. It is producing gasoline economically without using water for processing.

Flexibility is a key feature of this new plant which is operated for a combination of companies by the Pure Oil Company. Initially it is handling 10,000,000 cubic feet of gas per day. Ultimately it may go as high as 20,000,000 cubic feet per day. The plant utilizes two stages of refrigeration coupled with four stages of gas compression to meet maximum summer temperatures. During the winter it is possible to divert compressor capacity from refrigeration to additional gas processing.

The Adena plant is designed for winter conditions similar to those experienced at other cold country plants designed and built by Stearns-Roger.

**Whatever the design problem, Stearns-Roger is fully prepared—a "one-stop" service for design, engineering, manufacture, construction, testing. TAKE IT UP WITH STEARNS-ROGER.**

**Stearns-Roger**

THE STEARNS-ROGER MFG. CO. DENVER, COLORADO

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## Plant Construction Still Quite Active

Unrelenting growth of the petrochemicals industry, the still-strong octane race, and the desire for greater production efficiency keeps petroleum-industry construction booming. As we go to press, there are more than 1000 major process units or plants in either the planning or construction stages around the world. Because many companies decline to disclose capital expenditures, it is difficult to place a dollar value on the volume of construction; some estimate it, however, at better than $2 billion.

Tar sand and shale oil developments should be watched closely; the blocking of the Suez has brought home dramatically the value of Middle Eastern oil to our economy. Already there is some concern being expressed on the drain that is and will be placed on our irreplaceable crude oil reserves. The Navy now expects little or no resistance from Congress in its request for funds to resume operations of the Rifle, Colorado, experimental shale oil plant. Union Oil Company has virtually completed a retorting plant in the southwestern Colorado area. SoCal's subsidiary, American Gilsonite, is well on the way to completing its plant for turning solid bitumen into oil products. Also, U. S. and Canadian companies are intensifying research efforts on economical means for exploiting Alberta's vast tar sand deposits.

Major petrochemical activity is centered in the Southwest. Synthetic rubber is getting especial attention; becoming "common" are combination butadiene-aviation gasoline plants. Dehydrogenation units provide butadiene for synthetic rubber manufacture, also butenes for alkylation with field isobutane. The obvious result is a strain on butane and isobutane supplies, especially the latter.

The ultimate result of the introduction of super-premium gasolines remains to be determined — largely by Detroit. If they decide to take even greater advantage of the premium fuels by putting ultra-high compression ratio engines in popular priced cars, look for another round of octane-improvement projects. While catalytic reforming is still rolling, major emphasis can be expected in processes that extract high-octane components from lower octane mixtures of paraffins, olefins, isoparaffins, and aromatics. Possible shortages of butanes may retard expansion of alkylation capacity. Several operators are now thinking twice about building units that would have depended upon "outside" sources of iso- and n-$C_4$'s.

Whatever your requirements, you'll find valuable experience and modern, complete fabricating facilities at Glitsch. And once we do a job for you, we know you will call us back because you will like the way our "single engineering responsibility" complements your own production program. If you require any kind of specialty fabrication . . . for *any* process plant . . . call in Glitsch. Then you're assured of getting your job done right, and right on time.

If you would like more information on Glitsch fabricating facilities, write us at P. O. Box 6627 in Dallas and ask for a copy of our Catalog 155. There's no obligation of course.

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FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | | **Esso Standard S. A. F.** | | | |
| — | Esso Research and Engineering Co. | Port Jerome, France | Catalytic Cracker | 10,000 BPD | $10,700,000 | Early 1957 |
| | | | Powerformer | 14,500 BPD | — | 1959 |
| — | " | Bordeaux, France | Refinery | — | — | " |
| | | | **Farbenfabriken Bayer** | | | |
| — | Scientific Design | Dormagen, Germany | Crude Oil Cracking Plant | 26,000,000 lb/hr | — | — |
| | | | **Federated Cooperatives Ltd.** | | | |
| — | — | Regina, Saskatchewan, Canada | Crude Distillation Unit | 16,000 BPD | — | 1957 |
| — | — | " | Revamp Thermal Cracking Unit | 1000 BPD | — | " |
| | | | **Gas and Fuel Corporation of Australia, Ltd.** | | | |
| Head Wrightson Processes | Same | Morwell, Australia | Gas Dehydration Plants | 36,000 CF/D | — | — |
| | | | **Gewerkschaft Erdoel-Raffinerie Elmsland** | | | |
| Lummus Co., Ltd. | Houdry | Lingen, Germany | Houdriformer | 3500 BPD | — | — |
| | | | **Golfo IP s. p. a.** | | | |
| Tecnider s. p. a. | Same | Gaeta, Italy | Topping | 15,000 BPD | — | 1957 |
| " | " | " | Gasoline Treating | 3000 BPD | — | " |
| " | " | " | Kerosine Treating | 3000 BPD | — | " |
| " | " | " | Catalytic Reformer | 3000 BPD | — | " |
| | | | **Greek Government** | | | |
| Hydro-Krupp | Hydro Res., Inc. | Piraeus, Greece | Refinery | 30,000 BPD | $15,000,000 | Jan. 1957 |
| | | | **W. R. Grace Co.—Farbwerke Hoechst** | | | |
| — | — | Sao Paulo, Brazil | Polyethylene | — | — | — |
| | | | **Idemitsu Kosan Company** | | | |
| Japan Gasoline Co. | Universal Oil Products Co. | Tokuyama, Japan | Refinery | 30,000 BPD | $25,000,000 | — |
| | | | **Imperial Chemical Industries, Ltd.** | | | |
| Company Staff and Power-Gas Co. | (Texaco License) | Billingsham, England | Ammonia | 200 T/D | — | — |
| | | " | Alchohols | 40,000 T/D | — | Jan. 1957 |
| M. W. Kellogg and Co. and Kellogg International Corp. | — | Wilton, England | Oil Cracker | — | $48,000,000 | Early 1959 |
| | | | **Imperial Oil Company, Ltd.** | | | |
| — | Esso Research and Engineering Co. | Winnipeg, Manitoba, Canada | Powerformer | 2500 BPD | — | — |
| | | | Crude Capacity | — | — | — |
| Fluor Corp. of Canada, Ltd. | " | Montreal E., P.Q., Can. | Powerformer | 9000 BPD | $4,500,000 | 1957 |
| Canadian Bechtel | " | Ioco, B. C., Canada | Powerformer | 4000 BPD | — | Sept. 1957 |
| — | " | Halifax, N. S. | Cyclic Powerformer | 7000 BPD | — | 1957 |
| Fluor Corp. of Canada, Ltd. | Same | Sarnia, Ontario, Canada | Detergent-Alkylate Plant | 30,000,000 lb/hr | $3,800,000 | 1958 |
| — | — | " | Olefins-Ethylene, Propylene, etc. | 10,000 BPD | $25,000,000 | " |
| | | | **India Government** | | | |
| — | — | India | Refinery | 30,000 BPD | $40,000,000 | — |
| | | | **International Synthetic Rubber Company, Ltd.** | | | |
| — | Blaw-Knox | Fawley, England | Synthetic Rubber Plant | 50,000 T/yr | $10,000,000 | 1957 |
| | | | **Isiom** | | | |
| — | — | Palermo, Sicily | Refinery | 12,000 BPD | — | 1957 |
| | | | **International Petroleum (Colombia), Ltd.** | | | |
| Bechtel Corp., S. A. | C. F. Braun and Esso Engineering and Research | Cartagena, Colombia, S. A. | Two-Stage Pipestill and Stabilizer | 28,000 BPD | $ 2,830,000 | Late 1957 |
| | | | Fluid Catalytic Cracking Unit | 13,130 BPD (ff)<br>25,028 BPD (tf) | $ 3,680,000 | " |
| | | | Cat. Poly | 1660 BPD | $ 1,440,000 | " |
| | | | Light Ends Recovery | 2.83 MMCF/D | $ 1,570,000 | " |
| | | | LPG Deethanizer | 580 BPD | $ 130,000 | " |
| | | | Catalytic Naphtha Treaters | 7720 BPD | $ 500,000 | " |
| | | | Virgin Naphtha, Kero Treaters | 15,820 BPD | — | " |
| | | | Offsites, etc. | — | $22,350,000 | " |
| | | | | Total Cost..... | $32,500,000 | |
| | | | **Korean Government** | | | |
| Hydro. Res. Inc. | Same | Chung-Ju, Korea | Urea Plant | 185 T/D | $25,000,000 | — |
| | | | **Kuwait Oil Company, Ltd.** | | | |
| E. B. Badger and Sons, Ltd. | Same and Bechtel, G. Wimpey, and Co., Ltd. | Mina-al Ahmadi, Kuwait | Atmospheric Distillation | 160,000 BPD | — | Dec. 1957 |
| | | | **Lago Oil & Transport Company** | | | |
| Badger Mfg. Co. | Same | Aruba, D. W. I. | Hydrofiner | 20,000 BPD | $3,000,000 | 1957 |
| | | | **McColl-Frontenac Oil Company, Ltd.** | | | |
| The Refinery Engineering Co. | Universal Oil Products Co. and Treco | Edmonton, Alberta, Canada | Platformer | 3300 BPD | $900,000 | Early 1957 |
| — | — | Montreal E., P. Q., Canada | Hydrotreating Unit | 10,000 BPD | — | Late 1957 |

DU PONT *Petroleum Chemicals* NEWS

One of a Series of Bulletins for the Petroleum Industry

JANUARY 1957

# New Du Pont presentation will inform public on oil industry

## DU PONT VICE-PRESIDENT

JOHN F. DALEY, a director of the American Petroleum Institute and a member of the Institute's General Committee, Division of Refining, was recently appointed a vice-president of the Du Pont Company.

Mr. Daley joined the Du Pont Company in 1915 as a timekeeper in the explosives plant at Carney's Point.

When made a vice-president he also became a member of the executive committee and director of Du Pont. Prior to holding these positions, Mr. Daley was general manager of the Organic Chemicals Department, which includes the Petroleum Chemicals Division.

In 1940, Mr. Daley's experience in explosives manufacture was made available to the government. During the war, he served as manager of the Indiana Ordnance Works and as deputy field director of ammunition plants, with jurisdiction over 55 government-owned plants. For this work, he was awarded a commendation for exceptional civilian service by the Secretary of War.

He returned to Du Pont as director of pigments sales in 1944, later becoming general manager of the Pigments Department. He was appointed general manager of the Organic Chemicals Department in 1948.

A clear, concise—yet highly dramatic—explanation of our American business system is packed in the small, lightweight briefcase pictured below. It's a presentation kit with a story woven closely around oil industry products and activities. Tentatively, it has been named "A 'Brief' Case for Business."

The theme of the story is that the *customer* actually makes the important business decisions today. It also points up very clearly the interdependence of big and little businesses in filling customer needs.

**PETROLEUM PLAYS** an important part in the production of all the items in this presentation kit. And the entire kit fits compactly into the lightweight easy-to-carry briefcase.

This public relations presentation—prepared by the Du Pont Petroleum Chemicals Division—shows how oil is truly the lifeblood of American industry. Yet its points are made in such a way that they are applicable to almost any segment of our economy. The audience appeal of this presentation is, therefore, exceedingly broad.

### "Magic Barrel" idea

The new briefcase kit tells an oil industry public relations story in much the same way as the popular "Magic Barrel" has been doing so successfully for a number of years.

The briefcase is not meant to replace the "Magic Barrel," which will be continued. Rather it is to supplement that program. It can be presented to groups who have already seen the Barrel, or where the Barrel is for some reason not feasible or appropriate. The new presentation has been streamlined, including fewer items than the Barrel. These items, however, have been carefully selected to tell the story forcefully.

### Low cost

Another advantage of the briefcase is its low cost . . . only $50 including all the products in it.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

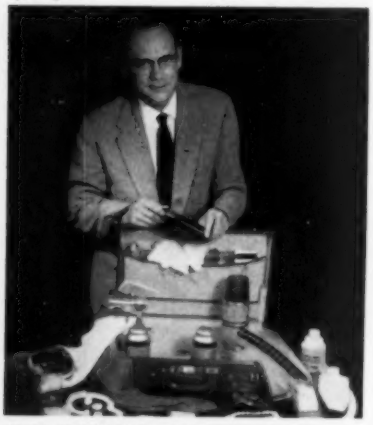
# DU PONT *Petroleum Chemicals* NEWS

CONTINUED

## New Presentation

Within the oil industry, there are now about 1200 speakers trained to give the "Magic Barrel" presentation. These men and women can, with practically no additional training, present the new program. And to acquaint them quickly with the new kit, we are supplying complete instructions as well as an easy-to-follow script.

**THE NEW** petrochemicals presentation is easy to learn, easy to give, yet high in dramatic quality . . .



**H. C. THOMPSON,** assistant promotion manager, demonstrates.

### Now available

This new presentation is being sponsored by the Oil Industry Information Committee. To order these kits, or for further information about them, just get in touch with one of our representatives at the nearest Du Pont Petroleum Chemicals Division office listed below.

We will also be glad to train as presentation speakers—at no cost to refiners—any personnel who are not familiar with this type of public relations program.

## DuPont Estersil GT solves problem of "leaking greases"

Crane and power shovel operators, among others, are reporting unusually satisfactory results from greases made with Du Pont Estersil GT (grease thickener).

One contracting company, for example, wanted a grease which would not leak on hoist drum brake bands, particularly at high ambient temperatures. A number of different greases were tried with no success in solving the problem.

The contractor's petroleum supplier then suggested an estersil-based grease. This type of grease will not break down even under severe high-temperature, high-shear working conditions.

The experiment was an outstanding success. The estersil grease was used on three different crane hoists. In all cases, the leakage problem was completely solved.

Conversely, estersil greases also have properties that are the answer to many extremely low-temperature lubricating problems. Since wide temperature changes produce little change in their consistency, there is little danger of estersil greases losing their lubricating value in sub-zero temperatures.

### High water resistance

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## Film dramatizes oil industry expansion

"It Never Rains Oil" is an animated color cartoon about a very serious subject.

It tells how percentage depletion helps to keep oil production ahead of the world's mushrooming demand. You have probably seen the film and of course know the value of percentage depletion.

However, the point of this suggestion is—shouldn't *more* and *still more* people be informed on this important subject?

Movie prints are still available for your use. In case you know of some other groups who should see it . . . new personnel employed over the past two years, for instance . . . write for the film.

Planned and produced by the Du Pont Petroleum Chemicals Division, the film is sponsored and distributed by the American Petroleum Institute, Independent Petroleum Association of America, Mid-Continent Oil and Gas Association, Rocky Mountain Oil and Gas Association and Western Oil and Gas Association.

## Big and small businesses work together

The tremendous amount of business generated by "big business" for "small business" is pointed up in a new survey by the Du Pont Company. It shows that small firms represent 90% of Du Pont's 75,000 customers and 30,000 suppliers.

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OVER

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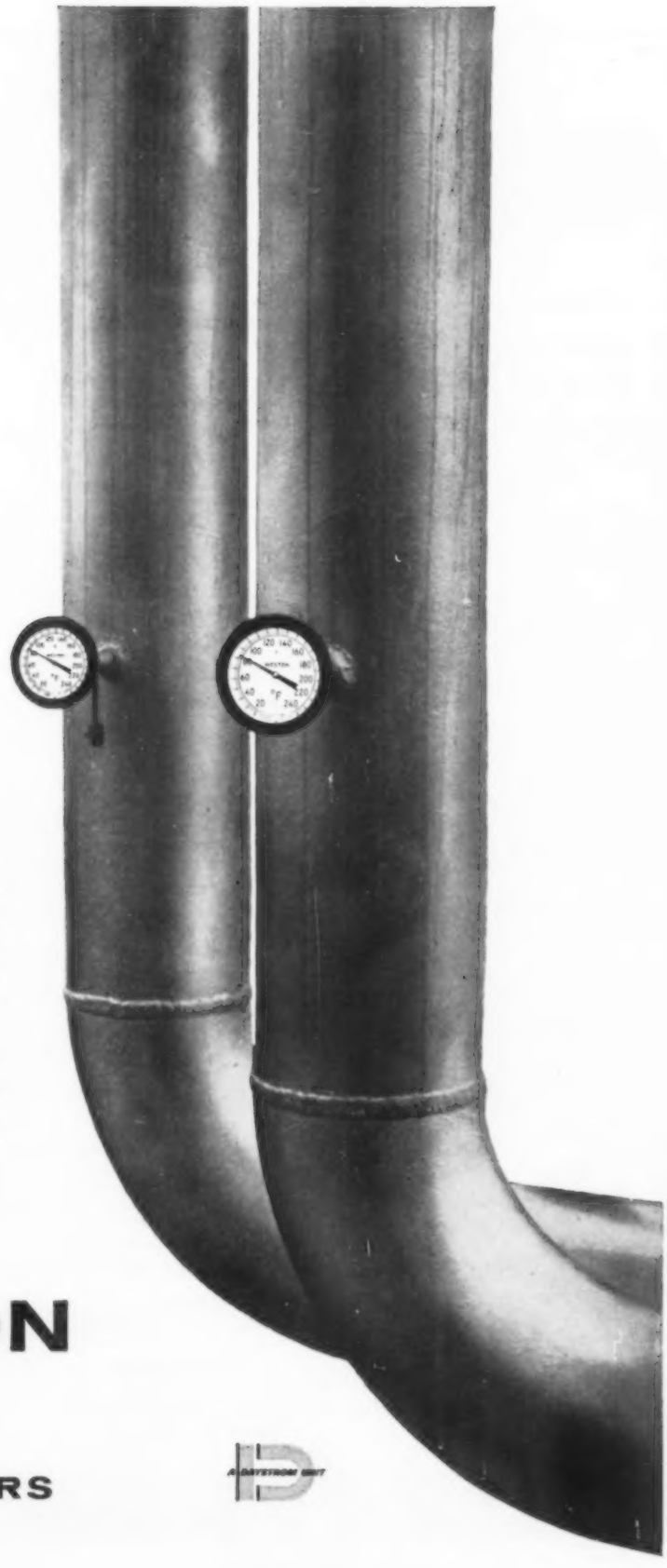

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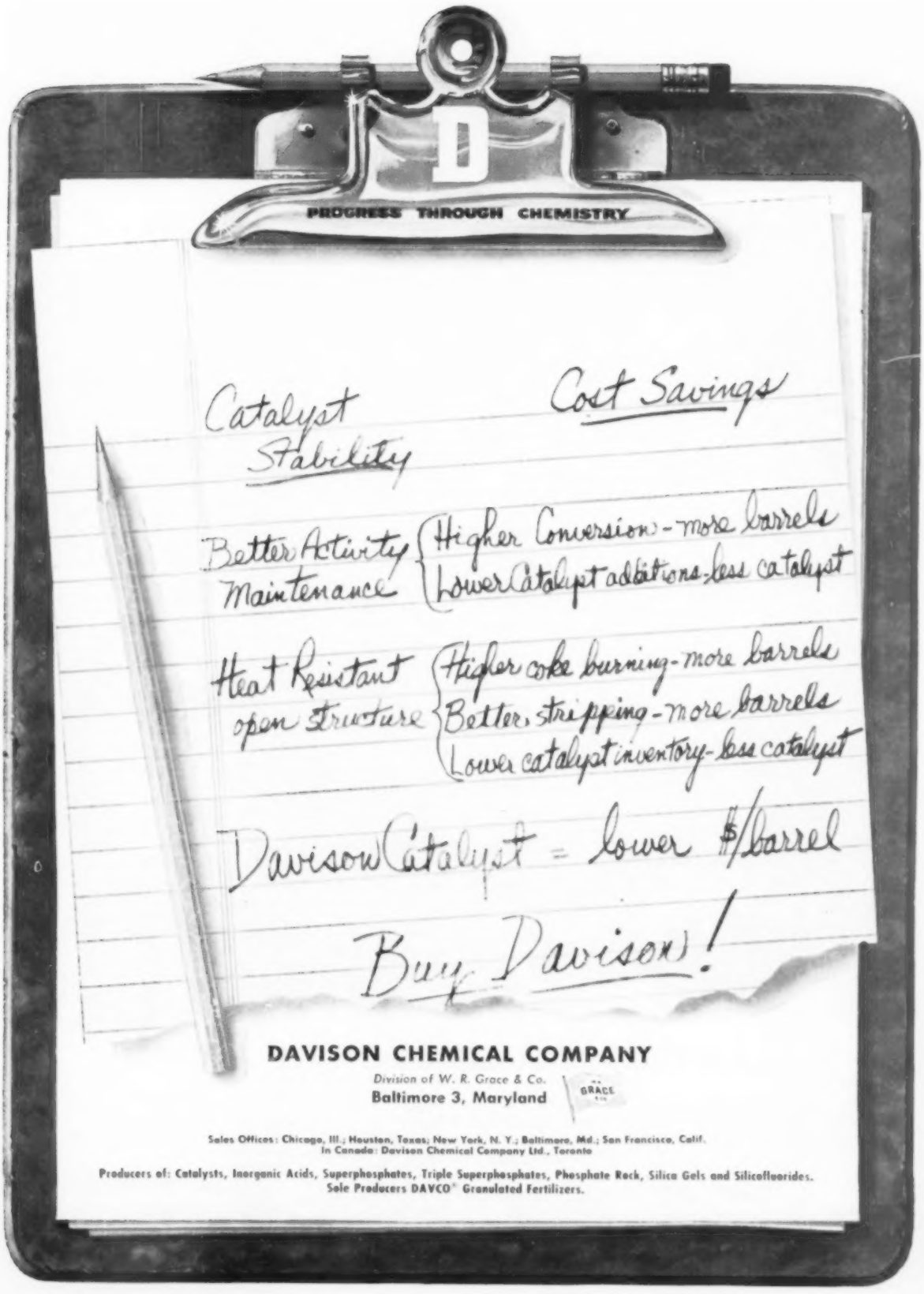
FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | **Midland Petroleum and Pacific Petrochem** | | | | |
| — | — | Stettler, Alta., Canada | Crude Refinery | 4000 BPD | $2,000,000 | 1957 |
| | | **Mitsui Group** | | | | |
| Stone and Webster Engineering Co. | Scientific Design, Inc. | Iwakuni City, Japan | Petrochemicals, Ethylene and Oxide, Cumene, Glycol | — | $30,000,000 | 1957 |
| | | **Naphtachimie** | | | | |
| — | Badger Div., Stone and Webster | Lavera, France | Ethylene Oxide Expansion | — | $17,500,000 | — |
| | | **Neste Oy** | | | | |
| Compagnie de FIVES-LILLE | Lummus Co., Ltd. | Naantali, Finland | Refinery | 18,000 BPD | $17,000,000 | April 1957 |
| | | **Nihon Gas Kagaku Kogyo** | | | | |
| Chemical Construction Co. | Same | Niigata, Japan | Urea | 905 T/D | $2,100,000 | Early 1957 |
| " | " | " | Ammonia | 100 T/D | — | " |
| " | " | " | Ammonium Sulfate | 200 T/D | — | Late 1957 |
| | | **N. V. Bataafsche** | | | | |
| Badger Div. Stone and Webster | Commercial Solvents | Pernis, Holland | Glycerine | — | $7,000,000 | 1957 |
| | | **Pacific Petroleums, Ltd.** | | | | |
| — | — | Ft. St. John, B.C., Canada | Gas Absorption Plant | — | $18,000,000 | Late 1957 |
| — | — | " | Sulfur Recovery | 100,000 Long T/yr | — | " |
| | | **Pemex** | | | | |
| Hudson Engineering Co. | Same | Mexico City, Mexico | Natural Gasoline Plant | 300,000,000 CF/D | $7,000,000 | March 1957 |
| A. G. McKee Co. | Phillips, Esso Research | " | Catalytic Cracker | 16,000 BPD | $12,000,000 | Mid 1957 |
| " | " | " | Poly Unit, Alkylation Unit, Ethylene, etc. | — | — | — |
| " | Same and Phillips | Ciudad Madero, Mexico | Catalytic Cracker | 16,000 BPD | $25,000,000 | Late 1957 |
| " | " | " | Alkylation, Poly Units | — | — | — |
| " | " | " | Topping, etc. | 100,000 BPD | — | — |
| Fluor Corp., Ltd. | Same and Staff | Minatitlan, Mexico | Vacuum Unit | 1000 BPD | $4,000,000 | Early 1957 |
| A. G. McKee Co. | Same and Staff | Salamanca, Mexico | Catalytic Cracker | 12,000 BPD | $4,000,000 | " |
| | | **Petrobras** | | | | |
| M. W. Kellogg Co. | Same | Mataripe, Brazil | Refinery Expansion | 32,000 BPD | — | Late 1957 |
| " | " | " | Thermal Cracker | 5000 BPD | — | " |
| " | " | " | Lube Unit | 3000 BPD | — | " |
| " | " | " | Wax Unit | 120,000 lb/D | — | " |
| | | **Polychem Limited** | | | | |
| — | — | Bombay, India | Polystyrene Plants (2) | 6,000,000 lb/yr | — | — |
| | | **Quebec Ammonia** | | | | |
| Girdler | Same | Montreal, P.Q., Canada | Ammonia Nitric Acid | 120 T/D | $8,000,000 | Mid 1957 |
| | | **Raffinerie Belge de Petroles, S. A.** | | | | |
| Kellogg International Corp. | Same | Antwerp, Belgium | Catalytic Reformer and Desulfurizer | 2500 BPD | $2,000,000 | March 1957 |
| | | **Raffineria Garrone** | | | | |
| — | Esso Research and Engineering Co. | Genoa, Italy | Powerformer | 5600 BPD | — | 1957 |
| | | **Raffineria de Petroleos** | | | | |
| Foster Wheeler Corp. | Same and UOP | Escombreas, Spain | Platformer | 11,000 BPD | — | 1957 |
| " | " | " | Topping Unit | 25,000 BPD | — | " |
| | | **Rasiom** | | | | |
| — | Esso Research and Engineering Co. | Augusta, Sicily | Powerformer | 7300 BPD | — | 1957 |
| | | **Regent Refining, Ltd.** | | | | |
| Procon, Inc. | Same and UOP | Port Credit, Canada | Adding Crude Capacity | 6000 BPD | — | Early 1957 |
| " | " | " | Visbreaker | 3000 BPD | — | " |
| " | " | " | Vacuum Unit | 10,000 BPD | — | " |
| " | " | " | Fluid Catalytic Cracker | 7000 BPD | — | " |
| " | " | " | Catalytic Poly Unit | 730 BPD | — | " |
| | | **Saint-Gobain and Batignolles-Chatillon** | | | | |
| — | Societe Belge de L'Azote | Monclova, Mexico | Nitric Acid Plant | — | — | — |
| | | **Sf de Petroles Bp** | | | | |
| — | — | Lavera, France | Ethylene | Up to 18,000 T/yr | — | — |
| — | — | " | Propylene | " | — | — |
| | | **Shell Oil Company** | | | | |
| — | — | Philippines | Refinery (Proposed) | — | — | — |
| — | Marani and Morris | Toronto, Ontario, Canada | Office Building | 12 Stories | $4,500,000 | Dec. 1958 |
| | | **Shell Oil Co. of Canada, Ltd.** | | | | |
| A. G. McKee Co. | Same | Montreal E., P. Q., Canada | Crude Topping and Treating | 25,000 BPD | $2,500,000 | Mid 1957 |
| Staff | Fluor Corp., Ltd. | " | Asphalt | 600 T/D | $1,200,000 | " |
| The Refinery Engineering Co. | UOP | " | HF Alkylation | | | |
| | | | Detergent | 400 BPD | $3,000,000+ | Late 1957 |
| | | | Motor | 1500 BPD | | |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| Construction Company | Engineering and Design Company | Location | Type of Plant or Unit | Rated Capacity | Cost | Scheduled for Completion |
|---|---|---|---|---|---|---|
| | | **Shell Oil Company of Venezuela, Ltd. (The)** | | | | |
| — | — | Cardon, Venezuela | Catalytic Cracker | 33,000 BPD | | Fall 1957 |
| — | — | " | Distillation | 80,000 BPD | $20,000,000 | Mid 1957 |
| — | — | " | Alkylation | 1400 BPD | | " |
| | | **Shell Chemical Company, Ltd.** | | | | |
| Lummus Co., Ltd. | B. P. M. Comprimo Montecatini Pinch-Bamag-Lummus | Shell Haven, England | Ammonia Plant and Fertilizer Plant | 75,000 T/yr | $30,000,000 | 1958 |
| | | **Shell Refining and Marketing Company, Ltd.** | | | | |
| E. B. Badger, Ltd. | Stone and Webster, Badger Div. | Shell Haven, England | Atmospheric Distillation | 80,000 BPD | — | Mid 1958 |
| Own Labor | B. P. M. Comprimo Montecatini Pinch-Bamag | " | Gas Treating Facilities | 750 T/D | — | End 1957 |
| — | UOP | " | Platformer | 6700 BPD | — | — |
| | | **Sherritt-Gordon Mines, Ltd.** | | | | |
| — | — | Ft. Saskatchewan, Alberta, Canada | Anhydrous Ammonia | 75 T/D | $24,000,000 | — |
| | | **Showa Oil Company** | | | | |
| — | — | Tokuyama, Japan | Refinery | 30,000 BPD | $39,000,000 | June 1957 |
| | | **Societe Du Caoutchouc Butyl** | | | | |
| — | — | Le Harve, France | Synthetic Rubber Plant | 20,000 T/yr | — | Mid 1958 |
| C. F. Braun | Esso | Port Jerome, France | Butyl Rubber Plant | 20,000 T/yr | $15,000,000 | Mid 1958 |
| | | **Societe Francaise De Petroles Bp** | | | | |
| — | — | Marseilles, France | Crude Unit, etc. | 16,000 BPD | — | Late 1957 |
| | | **Socony Mobil Oil Company, Inc. (Mobil Oil A. G.)** | | | | |
| C. F. Braun Co. | Same and Staff | Bremen, Germany | Hydrodesulfurization | 6000 BPD | $1,750,000 | Early 1957 |
| | | **South Eastern Gas Board** | | | | |
| Power-Gas Corp. | Same | Refinery, Isle of Grain, Kent, England | Segas Catalytic Oil-Gas Unit | 20,000,000 CT/D | — | 1958 |
| | | **SPA Tecnico Industriale Aquila** | | | | |
| Staff | Same | Trieste, Italy | Catalytic Cracker | 3300 BPD | — | — |
| " | " | " | Catalytic Poly Plant | 1400 BPD | — | — |
| | | **Standard Oil Company of California** | | | | |
| — | — | Hawaii | Refinery | 25,000 BPD | $30,000,000 | Late 1957 |
| | | **Standard Oil Company (New Jersey)** | | | | |
| — | Planning | Oslo Fjord, Norway | Refinery | 40,000 BPD | — | — |
| | | **Stanic** | | | | |
| — | Esso Research and Engineering Co. | Bari, Italy | Powerformer | 7300 BPD | — | 1957 |
| | | **Sumitomo Chemical Company, Ltd.** | | | | |
| Stone and Webster Engineering Corp. | — | — | Ethylene Plant | — | — | — |
| | | **Taiwan Fertilizer, Ltd.** | | | | |
| Staff | Hydro. Res., Inc. | Nankong, Formosa | Ammonia Plant | 260 T/D Urea | $18,000,000 | Spring 1957 |
| | | **The Texas Company** | | | | |
| — | — | Santiago, Cuba | Refinery | 20,000 BPD | | |
| Procon, Inc. | Same and UOP | " | Platformer | 3300 BPD | | |
| " | " | " | Hydrotreater | 4100 BPD | $14,000,000 | Early 1957 |
| " | " | " | Gasoline Sweetening Crude Unit | 1400 BPD | | |
| Fred Snare Corp. | Same | " | Steamer Dock | — | | |
| | | **Union Carbide Caribe** | | | | |
| — | — | Ponce, Puerto Rico | Ethylene Glycol | — | $28,500,000 | 1958 |
| — | — | Santos, Brazil | Polyethylene | — | | |
| | | **Venezuelan Government** | | | | |
| Air Products, Inc. | — | Venezuela | Air Separation Plant | 120 T/D Ammonia | $1,000,000 | — |
| " | — | " | Hydrogen Purification Plant | | | |
| Blaw-Knox Co. | — | Moron, Venezuela | Refinery | 3000 BPD | | |
| " | — | " | Caustic Soda | 11,200 T/yr | $60,000,000 | 1957 |
| " | — | " | Commercial Solvents | 10,000 T/yr | | |
| " | — | " | Chemical Fertilizers | 150,000 T/yr | | |
| | | **Venezuela Gulf Refining Company** | | | | |
| M. W. Kellogg | — | Puerto La Cruz, Venezuela | Orthoflow FCC | 6660 BPD | $5,000,000 | Dec. 1956 |
| | | **X-L Refineries, Ltd.** | | | | |
| B. D. Bohna and Co., Ltd. and E. V. Lane Corp. | Koch Engineering Co., Inc. | Dawson Creek, B. C., Canada | Houdriformer | 500 BPD | — | — |

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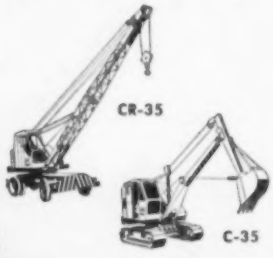


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## Decisions . . .

"Adequate control information is needed if the right investment decisions are made," L. F. McCollum, president of Continental Oil Company, recently told members of the Division of Finance and Accounting, American Petroleum Institute, at the Conrad Hilton Hotel, Chicago.

"Executive management must turn to the finance and accounting functions for this information," McCollum said. "The most astute financial planning is required to provide the necessary funds for making the heavy property investments required. For that reason, the finance function has always been and will continue to be extremely important in the oil and gas industry."

John G. McLean, Continental vice president, demonstrated before the group the manner in which Continental directs its reporting and control functions.

In describing the evolution of the company's present system, McLean told the oilmen. "The first major advance in our thinking came when we clearly recognized the fact that we would always need three fundamentally different kinds of reports: Accounting, special, and control reports."

The former Harvard Business School professor pointed out that it is a serious mistake to mix the three together or to try to make one type of report serve the purpose of another.

Where a company attempts to operate with accounting and special reports alone, he went on to say, the senior executives will be deprived of the continuing broad view of the business which is necessary to the formulation of policies and general strategies.

Some of the benefits gained from Continental Oil's system, McLean stated, include:

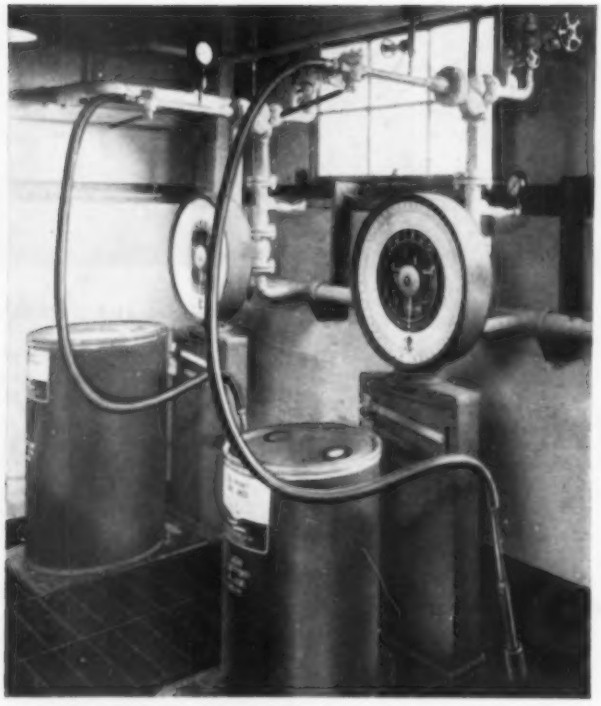
A. Giving to management a basis for evaluating performance and following progress in the various segments of the business;

B. A means of focusing the attention, thinking, and effort of management on certain chronic problems;

C. The elimination of burdensome staff work, and

D. Establishment of a basis within the company for further growth and expansion.

"At the very best," he concluded, "control reports can facilitate the exercise of human judgment — but can never serve as a substitute for it."



NEW DU PONT dye drumhead has an opening through which new probe can be readily inserted and manipulated. The two developments increase efficiency, save both time and money and eliminate dusting in the dry-dye eduction process.

This is a close-up view of special opening which accommodates dry-dye eduction probe. Opening can be resealed with standard 2-inch pipe cap.

THIS BOOK on Du Pont petroleum dyeing has just come from the press. You will find it a valuable reference, comprehensively covering the subject.

# Here are two more big reasons to use Du Pont dyes

**New probe:** Only six months ago Du Pont introduced an eduction probe of revolutionary design. It greatly facilitated the dry-dye eduction process, and solved the problem of clogging.

Now the same engineers who developed the probe have developed a new drumhead, also radically different from the conventional type, reducing dusting to an absolute minimum.

**New drumhead:** The drumhead, though removable, need never be taken off. It has a 2-inch circular opening just large enough for insertion of the probe. The small plastic disc sealing the opening can be easily removed with a pocketknife.

The drumhead opening is rimmed with plastic which is threaded to accommodate a standard 2-inch pipe plug. That means easy resealing to protect the quality which is built into all Du Pont dyes.

**Petroleum dye book:** A comprehensive book on the whole petroleum-dyeing subject has just been printed. It includes solubility charts, spectrophotometer curves, data on latest dyeing methods, and the use of the new probe and drumhead described above. Copies of the book, "Du Pont Petroleum Dyes," may be obtained from any of the sales offices listed below.

**Product quality:** Du Pont petroleum dyes are popular throughout the industry because of their outstanding qualities . . . uniformity, stability, solubility, purity and strength. Colors include red, yellow, blue, orange and bronze. These can be combined to produce other colors.

All Du Pont dyes have been proved to give excellent results in greases, motor and heating oils, jet and diesel fuels—as well as in gasoline where they have been most widely used.

**Technical service representatives** will gladly give you further information on any phase of the subject of petroleum-products dyeing. They will also be glad to help you install a dry-dye eduction system to fit your requirements.

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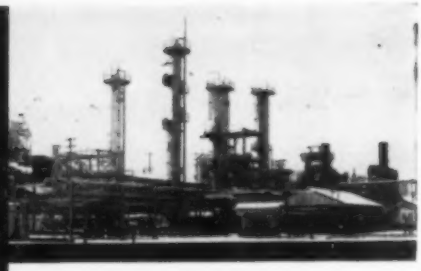
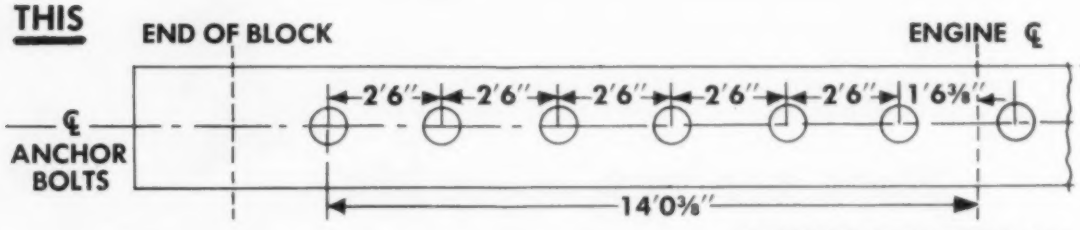
# IDEAS *at* WORK IN REFINING



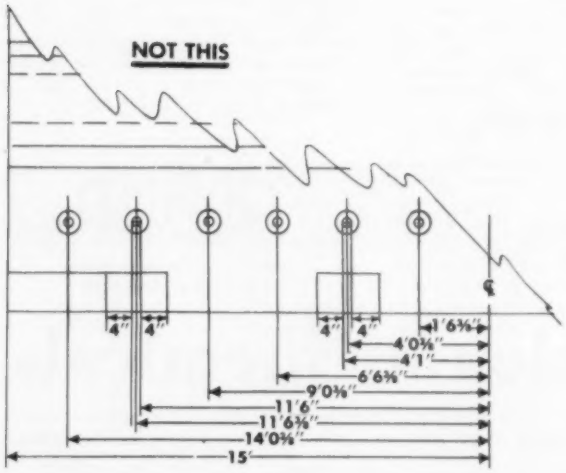
**Your Ideas Are Worth Money!**

If you have an operating idea or have devised a piece of equipment to do a job easier or cheaper, send it to us with a photo or drawing (we fix up rough sketches) . . . we will pay $10 for each idea used.

## How To Save Time and Money in Setting Anchor Bolts In Compressor Block




**ANCHOR BOLT TEMPLATE MADE FROM 2-2x12's**




Take a second look at the compressor block drawing. Notice the long string of dimensions that locate the position of the anchor bolts for the compressor. Each dimension relates back to the center line of the block with lateral dimensions from the centerline of the crankshaft.

Now put yourself in the place of the engineer in the field. The anchor bolt dimensions read something like this: 1 ft 6⅜ in. from centerline; 4 ft ⅜ in.; 6 ft 6⅜ in., etc.

Actually, the dimensions are not this complicated. The anchor bolts are 2 ft 6 in. or so apart and spaced to fit the engine. *Why not say so?* and then locate one of the anchor bolts with respect to the centerline of the engine.

Better still — why not make a drawing of the wooden templates that must be used to support the anchor bolts while the block is being poured? The only purpose of any drawing — so far as anchor bolts are concerned — is to insure that the anchor bolts fit the engine when it comes to rest on its proper centerline. Why complicate it?

Aside from the fact that simplicity reduces chances of error and speeds work, the template idea has another advantage. Once the anchor bolts have been hung from a template, checking the bolt tops is of little value. Should the bolt be inclined from the true vertical during the pour, the anchor bolt will truly fit the engine only at the template area anyway. So why not concentrate on the template?

# Delta Air Lines Gives $225,000 Bonus in U. S. Savings Bonds

*Delta Air Lines, Inc.*

GENERAL OFFICES · ATLANTA AIRPORT · ATLANTA, GEORGIA

C. E. WOOLMAN
*President and General Manager*
DELTA AIR LINES

TO: All Members of Delta Family

FROM: President and General Manager

This has been a difficult but successful year. Each of us has had a hand in our accomplishments.

Again we want to share our good fortune with all our people and it is a pleasure to announce that all personnel with more than six months of service as of May 24, 1956, will receive a $50.00 U.S. Savings Bond. All personnel with six months of service or less as of that date will receive a $25.00 U.S. Savings Bond. The total value of these bonds will be about $225,000.00.

The bond is both a share in our achievements and an added expression of appreciation for your contribution to them.

C.E. Woolman

Delta

If you are wondering whether *your* employees would prefer Savings Bonds to Cash . . . take a quick glance at these figures:

. . . 8,000,000 Americans enrolled in the Payroll Savings Plans of *40,000* companies invest $168 Million *per month* in U. S. Savings Bonds.

. . . 40,000,000 Americans hold $41 Billion (cash value) in Series E and Series H Savings Bonds . . . a huge reservoir of future purchasing power.

. . . 67% of *all* Series E Bonds that matured up to June, 1956—more than $21 Billion—are being held by their owners under the automatic extension program.

Join Delta Airlines—and many other fine companies—give your Bonus in Bonds—the gift that grows. Savings Bond Division, U.S. Treasury Department, Washington 25, D. C.

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**The Petroleum Engineer**

REFINING AND PETROCHEMICAL

# PERSONALS

**Everett M. Barger,** inventor of the Texaco combustion process, and supervisor of special engine research at the Texaco research center, Beacon, New York, has been presented the Richards Memorial Award by the American Society of Mechanical Engineers.

**Bruce K. Brown,** formerly president of Pan-Am Southern Corporation and during World War II, Deputy Administrator of Petroleum Administration for Defense in Washington, has been elected president and chief executive officer of Petroleum Chemicals, Inc., New Orleans, Louisiana.

**I. W. Scroggin** of New York City has been appointed assistant plant manager in charge of technical services for the Cities Service Oil Company's refinery at East Chicago, Indiana. He formerly served as staff engineer of the manufacturing department, Cities Service Petroleum, Inc., New York City.

**P. W. Judah,** manager of the lubricating department of Socony Mobil Oil Company, Inc., has been appointed manager of a newly-established petroleum chemicals department. **Paul A. White,** who has been associated with the company since 1937, has been named to succeed Judah. He formerly served as manager of the engine builders division in the lubricating department at the headquarters office in New York City.

**Robert G. Reed** has been appointed business manager of Escambia Chemical Corporation's research division. He will be responsible for the business functions and the non-technical administration of Escambia's research department.

**A. W. Pratt,** chief engineer in the process division for Stone & Webster Engineering Corporation, has joined E. B. Badger & Sons, Ltd., affiliate of Stone & Webster in London, as engineering manager. **T. E. Casselman** will replace Pratt. **Dr. R. L. Geddes,** consultant in the process division, has been appointed a consulting engineer for the corporation.

**Dr. J. Bennett Hill,** pioneer oil industry chemist, retired November 30 as director of Sun Oil Company's research and development department.

Dr. J. B. Hill

Dr. Hill has helped manage Sun's research program for the past 22 years. He joined the company in 1934 as manager of the development division, manufacturing department. He directed oil research for the Atlantic Refining Company prior to joining Sun.

**L. H. Betow,** Lake Charles, Louisiana, has been promoted to the newly created position of assistant to **Harold G. Osborn,** senior vice president of Continental Oil Company. Formerly resident chemist at Conoco's Lake Charles, Louisiana, refinery, he will make his new headquarters in Houston, Texas. Betow joined Conoco in 1944 as an analytical chemist at Ponca City, Oklahoma.

**R. J. Ronan** has been appointed regional manager-technical services, with headquarters in Beacon, New York, for The Texas Company. Ronan will be in charge of technical services for industries in 14 eastern and Middle Atlantic states.

**H. W. Ferguson,** Houston, Texas, has been named API vice president for refining. He is vice president of Humble Oil and Refining Company.

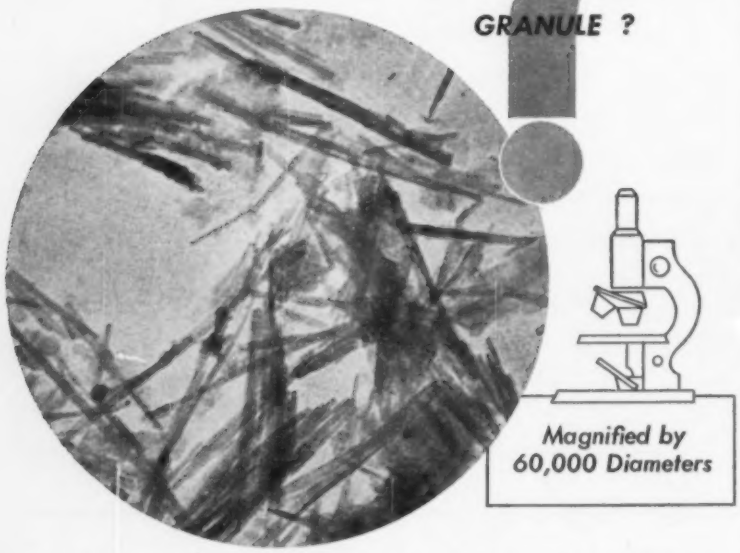
**Dr. Edward W. Comings,** head of the School of Chemical and Metallurgical Engineering, Purdue University, Lafayette, Indiana, has been named recipient of the William H. Walker Award for 1956 by the American Institute of Chemical Engineers.

**Dr. Robert Roy White,** professor of chemical engineering at the University of Michigan, has been selected as winner of Professional Progress Award in chemical engineering of the AIChE. It was also announced that **Theodore Weaver,** manager of the process development department of the Fluor Corporation, Ltd., Los Angeles, California, has been named winner of the 1956 Junior Award of the AIChE. Student Problem Contest Awards also were given by the AIChE, with first prize going to **Don Cianci** of Montreal, Quebec. Other winners were: **Maurice C. Lorenz,** Lafay-


EVER LOOK INSIDE A

Florex ?

GRANULE ?




The fibrous nature of Florida Fullers Earth, commercially available as Florex, reveals each unit consisting of about 2200 molecules in a bundle, providing ready selectivity in adsorption of color and contamination from organic and inorganic liquids and gases.

Florex quality means specially processed fullers earth giving maximum surface area and adsorption efficiency. Florex is unequalled in high quality or low cost for processes involving the use of highly active clay for sweetening light distillates, dehydration, desulfurization, and polymerization.

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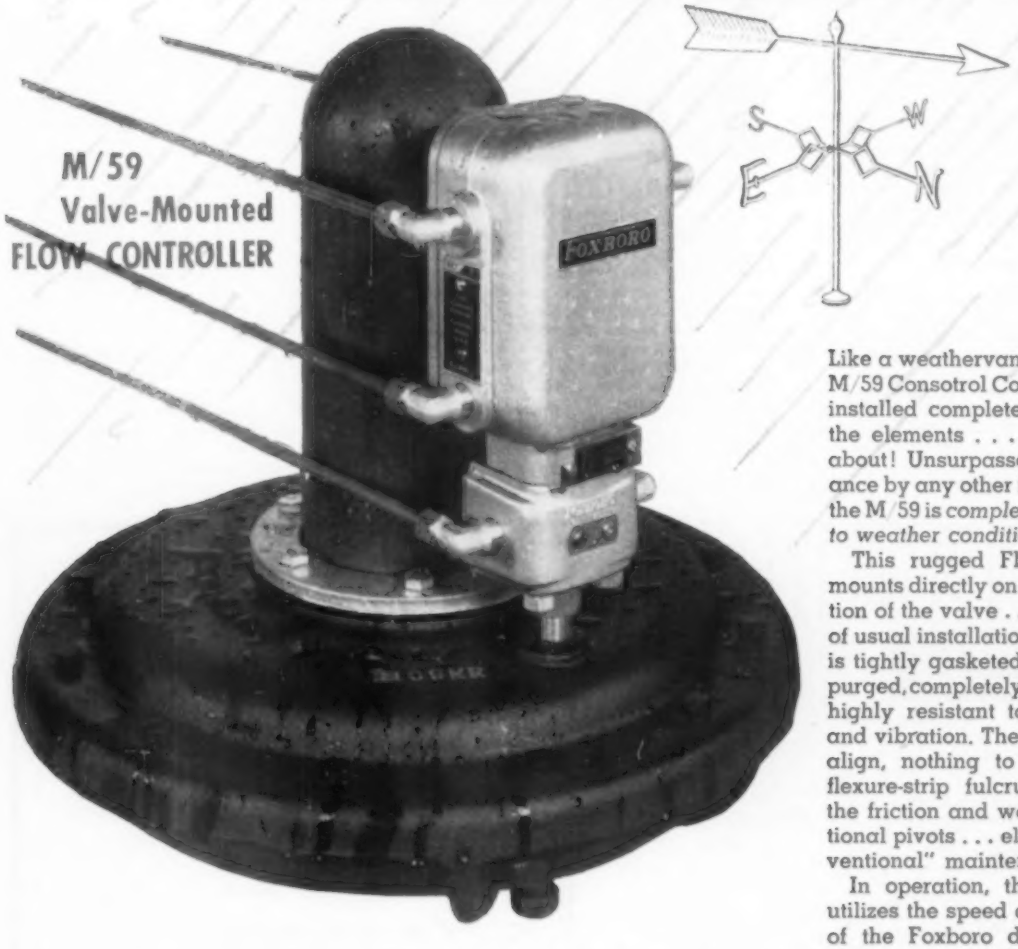
# This Controller requires no more attention than a weathervane!







Like a weathervane, the Foxboro M/59 Consotrol Controller can be installed completely exposed to the elements . . . and forgotten about! Unsurpassed in performance by any other flow controller, the M/59 is *completely indifferent to weather conditions.*

This rugged Flow Controller mounts directly on the air connection of the valve . . . at a fraction of usual installation cost. Its case is tightly gasketed, continuously purged, completely weatherproof, highly resistant to dust, fumes, and vibration. There's nothing to align, nothing to wear out. A flexure-strip fulcrum eliminates the friction and wear of conventional pivots . . . eliminates "conventional" maintenance.

In operation, the M/59 fully utilizes the speed and sensitivity of the Foxboro d/p Cell Flow Transmitter . . . does away with transmission lag . . . gives fastest recovery from process upsets. For the *complete* story, write today for Bulletin 470.

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**Unique Simplicity — exclusive design permits fixed, optimum proportioning and reset values for liquid flows. Adjustable reset optional for gas or steam flow.**

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FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND



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## Personals

ette, Indiana, second prize, and **Dave Kearns, Berkeley,** California, third prize. Honorable mention was awarded **Jack Voght,** Cleveland, Ohio, **Dale R. Albright,** Somerville, New Jersey, and **John M. Wetz,** Hardtner, Kansas.

**J. R. Dungan, Jr.** has been appointed assistant superintendent of gasoline plants for Lone Star Gas Company and Lone Star Producing Company. **M. M. Martin** of Tyler, Texas, has been promoted to process engineer and transferred into the general offices in Dallas, to succeed Dungan.

Also announced was the appointment of **J. A. Bates** of Ranger, Texas, to the newly created post of departmental superintendent of the gasoline department. **W. A. Robinson** succeeds Bates as West Texas district superintendent to supervise operations of gasoline plants at Gordon and Pueblo, Texas, and those in the Ranger-Breckenridge, Texas, area. **N. E. Landers,** in addition to present duties as superintendent of Lone Star's tank car shop, will supervise work of structure maintenance crews. **Ellis Gregory** has been promoted to senior foreman of the tank car shop.

All except Dungan and Martin will continue to operate from the Ranger district headquarters of Lone Star.

**Lloyd E. Lundahl,** Memphis, Tennessee, has been named chief engineer and assistant maintenance superintendent for Great Northern Oil Company, Pine Bend, Minnesota.

For the past two years Lundahl has been assistant chief engineer in charge of design and construction of plant facilities for the Grace Chemical Company, Memphis.

**Dr. George A. Harrington** has become general manager of development for Amoco Chemicals Corporation, affiliate of Standard Oil Company (Indiana). **Howard R. Peterson** has been named manager of special products in the marketing department of Amoco Chemicals.

They have joined the Chicago, Illinois, offices of **Jay H. Forrester,** Amoco Chemicals president-elect.

Dr. Harrington previously was market research director of Indoil Chemical Company. Peterson was vice president and manager of the sales department of Indoil.

T. A. Burtis

C. G. Kirkbride

**Theodore A. Burtis** has been elected president and chairman of the board of directors of Houdry Process Corporation, and has been named a director of the corporation's subsidiary, Catalytic Construction Company. He succeeds **C. G. Kirkbride,** who has joined Sun Oil Company as executive director of the research, patent and engineering departments, but will continue his association with Houdry as a member of the board of directors.

Transfer of the office of the manager of the rocket fuels division of Phillips Petroleum Company's research and development department from McGregor, Texas, to the company's headquarters at Bartlesville, has been announced. Moving as a result of the change are **E. A. Malick,** manager of the division, and three staff members: **J. A. McBride,** manager of technical planning, **J. M. Donohoe,** manager of facilities planning, and **W. R. Davison,** manager of program analysis.

**I. L. Coffman,** previously manager of the engineering and utility services branch of Air Force Plant 66 at McGregor, has been promoted to the newly created position of plant manager for the rocket fuels division at that location.

**Odell Campbell,** former manager of laboratories for E. I. du Pont de Nemours and Company in Tulsa, Oklahoma, has joined Kerr-McGee Oil Industries, Inc., Oklahoma City, Oklahoma, as technical assistant to **R. M. Chesney,** vice president in charge of refining.

**C. H. Whitman,** manager of Esso Standard Oil Company's crude oil purchasing department, Shreveport, Louisiana, and a member of the management committee of the company's Louisiana division, has retired from company service. He has been associated with the Esso Company for almost 42 years.

**A. K. May** has been named manager, sales research and development, of Jefferson Chemical Company. In his new post, he will be responsible for product diversification, development of new sales and the establishment of a program for recruiting and training personnel for the planned expansion of the marketing department.


PIPING HOT?

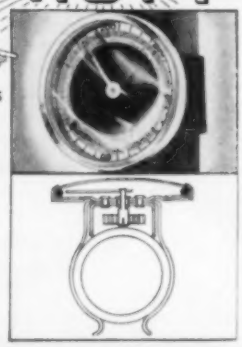
NEW PANDUX Pipe Thermometer

OBTAINS TEMPERATURE FAST WITH NO FUSS

NOW — no longer any need to disturb operations to learn pipe temperatures . . . Get temperatures quickly and accurately with the new Pandux Pipe Surface Thermometer. Fastens quickly by spring clip to pipe or tubing. Calibrated bimetal element protected by copper cup. Three models for ½" to 2" pipe. Two ranges: -50° F. to 250° F., and from 70° F. to 370° F.

Priced at $6.75 FOB LOS ANGELES

Specify range and pipe size.



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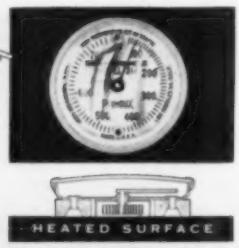
Fast, accurate temperature check from 50° F. to 750° F. for all hot surfaces, flat or rounded. Widely used for hot plates, platens, dies, molds, ovens, furnaces and many other industrial applications. Thermometer is affixed to surface by two Alnico magnets.

FOB LOS ANGELES $6.75

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# PROPERTIES OF INFRARED TRANSMITTING MATERIALS

| Material | Long wavelength transmission limit (microns) | Index of refraction ($N_D$) | Cold water solubility (gms/100ml) | Also soluble in | Maximum size | Relative cost | Description of material |
|---|---|---|---|---|---|---|---|
| Servofrax* (Arsenic Trisulfide Glass) | 12 | 2.59 | 0.000 | Alkali | Limited only by design considerations | Moderate | $As_2S_3$—Homogeneous, red glass. Stable. Non-toxic. Adaptable to all types and sizes of optics. Softening temperature—195°C. Useful for industrial instrumentation. Non-corrosive. |
| Silver Chloride | 23 | 2.07 | 0.000 | $NH_4OH$ $Na_2S_2O_3$ KCN | 4" Dia. | High | AgCl—Colorless, cubic crystal. Isotropic. No cleavage. Darkens in sunlight or artificial light with reduced I.R. transmission. Soft and malleable—subject to cold flow. Corrosive to metals. |
| Potassium Bromide | 27 | 1.55 | 53.48 0° C | Alcohol Glycerine | 7.5" Dia. | Moderate | KBr — Colorless, cubic crystal. Hygroscopic. Soft and easily scratched. Cleaves. |
| Sodium Chloride | 15 | 1.54 | 35.7 0° C | Glycerine | 7.5" Dia. | Low | NaCl—Colorless, cubic crystal. Hygroscopic. Cleaves. Scratches easily. |
| Sapphire | 5.5 | 1.77 | 0.000 | — | 2.5" Dia. | High | $Al_2O_3$—Hexagonal crystal. No cleavage. Does not scratch readily. Excellent mechanical strength. Good thermal properties. |
| Lithium Fluoride | 5 | 1.39 | 0.27 18° C | Acid | 5" Dia. | Moderate | LiF—Colorless, cubic crystal. Cleaves. Scratches easily. |
| Calcium Fluoride | 9 | 1.43 | 0.002 18° C | $NH_4$ Salts Solution | 6" Dia. | Moderate | $CaF_2$—Colorless, cubic crystal. Cleaves. Scratches easily. |
| KRS-5 | 38 | 2.63 | 0.02 0° C | $HNO_3$ aqua regia | 5" Dia. | High | KRS-5—Red, cubic crystal. No cleavage. Strains easily. Difficult to polish. High thermal expansion. Toxic. |
| Fused Quartz | 4 | 1.43 | 0.000 | HF | Limited only by practical optical homogeneity (6" Dia.) | Moderate | $SiO_2$—Good mechanical and thermal properties. Isotropic. |
| Silicon | 20 | 3.5 | 0.000 | HF $HNO_3$ | 1.5" Dia. | High | Si — Steel grey, cubic crystal. High melting point. Transmission decreases above 300° C. |
| Potassium Chloride | 21 | 1.49 | 34.7 20° C | Alkali Ether Glycerine | 7.5" Dia. | Moderate | KCl—Colorless, cubic crystal. Hygroscopic. Cleaves. Scratches easily. |
| Potassium Iodide | 31 | 1.67 | 127.5 0° C | Alcohol Ammonia | 7.5" Dia. | Moderate | KI—Colorless, cubic crystal. Very hygroscopic. Difficult to polish. Very soft. Cleaves. Scratches easily. |
| KRS-6 | 23 | 2.35 | 0.1 0° C | — | 7.5" Dia. | High | KRS-6—Colorless, cubic crystal. Toxic. |
| Cesium Bromide | 40 | 1.70 | 124.3 25° C | Alcohol | $1^3/_4$" Dia. | Moderate | CsBr—Colorless, cubic crystal. Hygroscopic. Soft. Easily scratched. |
| Glass | 3 | 1.5-1.9 | 0.000 | HF | No limit | Low | Homogeneous. Colorless. Easily cut, ground, polished. Non-toxic. |

* t.m.

*Courtesy of the Servo Corporation of America*

# NEW Refining Equipment

• machinery • supplies • services

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

**(41) Teflon Hose Assemblies.** In answer to industries' urgent need for safe, chemical-resistant flexible hose units having superior physical properties to rubber or metallic types, Mic-Lin announces the "Lin-Lok" line of Teflon hose assemblies.

Assembly consists of a Teflon liner encased in stainless steel wire braid with specially engineered full-flow fittings permanently locked to the hose. Units are capable of sustained operating pressures up to 4000 psi at temperatures from —100 to 500 F.

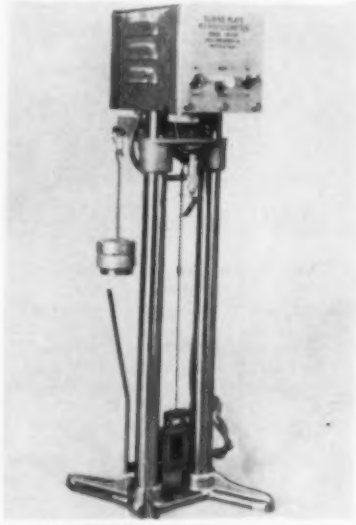
*The Mic-Lin Company.*

**(42) Valves Extend Application of Plastic.** Development of a series of general purpose, rigid PVC valves designed to operate under conditions generally considered beyond the capabilities of ordinary plastic materials is announced by Chemtrol.

Designed to withstand high temperatures and pressures too severe for ordinary plastic materials, the Chemtrol valves operate up to 170 psi, continuous duty, and in lower pressure systems may be used safely at temperatures up to 170F, or higher for intermittent duty. They are said to have excellent corrosion resistance, outstanding and constant-flow characteristics, and immunity to electrolysis and galvanic action.

*Chemtrol Corporation.*

**(43) Sliding Plate Microviscometer.** New instrument development of the Shell Development Company is being manufactured by Hallikainen Instruments.



The Sliding Plate Microviscometer was principally developed to measure the viscosity of asphalt. However, it can also be used on resins, plastics, and other viscous materials that will adhere to the glass sample plates. Accurate measurements permit the selection of asphalts with the proper viscosity and a great resistance to change.

*Hallikainen Instruments.*

**(44) Tank Insulation Materials.** Development of a flexible, foamed plastic sheet insulation that adapts itself to curved or irregular surfaces with little or no fitting or cutting has been announced by Armstrong Cork.

It is called Armaflex Sheet Insulation. Flexibility makes it particularly adaptable to insulating large tanks, irregular shaped vessels, oversize pipes and refrigeration equipment. Armaflex sheets have a k factor of 0.28 at 75 F mean temperature and a water vapor permeability of 0.1 perm. They are available in thicknesses of ⅛ in., ¼ in., ½ in., and ¾ in. in sheets 30 in. by 36 in.

*Armstrong Cork Company.*

**(45) Insulation Bands Expanded.** Problem of damaged insulation when hot tanks, towers, pipes, and vessels expand and contract is claimed to have been solved with the introduction of Breather Springs by Techalloy.

The only known bands which will follow tank line while gently holding insulation materials in place, according to the manufacturer, Breather Springs' secret is their ability to expand and contract.

Original application is safer because when Breather Springs start to stretch applicator knows bands are tight enough. Since Breather Springs expand and do not dig into insulation material, need for costly re-insulation jobs is drastically reduced.

*Techalloy Company, Inc.*

**(46) Easy-to-Apply Maintenance Coating.** Metal & Thermit has introduced a vinyl maintenance coating — Ucilon Coating 1400 — that is claimed to provide the corrosion resistance of previous vinyl-based coatings, but eliminates strong odors and the need for meticulous surface preparation.

Ucilon 1400 resists acids, alkalies, water, and other causes of early paint failure. It can be used for walls, floors, ceilings and the exteriors of equipment to resist corrosive fumes in chemical processing plants and other industrial atmospheres.

*Metal & Thermit Corporation.*

**(47) Petroleum Instrument for Low-Temperature Fractional Analyses.** A new petroleum instrument is said to increase the accuracy of low-temperature fractional analyses by eliminating holdup error and uncertainties in determining cutpoints.

Called the Cenco Vapor Pressure Apparatus, the instrument is used to analyze the binary mixture collection between plateaus of any two fractions and provides information regarding the composition of the original mixture.

Analysis is made of binary mixtures ranging from methane to isopentane, nitrogen content of natural gases, and cutpoint between isobutane and normal butane.

*Central Scientific Company.*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GLASSES
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All sizes to fit your gages and valves

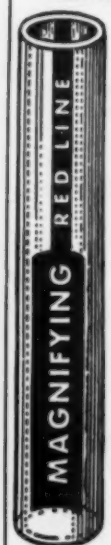

FIG. 22 SERIES 750

FIG. 21 LIP-MOLD

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2
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NAMES
ARE
JOINED!
SEE PAGES
A-18-A-19

**(48) Pre-Assembled Package Pilot Plant.** A pre-assembled pilot plant unit has been designed and constructed by Industrial

Process Engineers.

Shipped intact, including all valves and piping, it can be put into operation simply by connecting power and water lines, and installing the instruments (which are packed separately to prevent breakage).

Unit is intended for experimental production of a wide range of products. Design is based on specified physical properties, such as specific gravity, viscosity, boiling point, heat of reaction, insipient reaction temperature, and other laboratory data.

*Industrial Process Engineers.*

**(49) Super Booms.** Baldwin-Lima-Hamilton's answer to the demand for super booms in the construction market is the Lima Type 1250, a rugged, low-slung, air controlled machine, available also as a shovel or dragline.

Equipped as a crane, with a standard 60-ft boom, it has a lifting capacity of 100 tons at a 13-ft radius. Crane equipped with a 200-ft boom plus a 50-ft jib is designed to handle steel erection.

*Baldwin-Lima-Hamilton Corporation.*

**(50) Automatic Lever Control.** The Auto-Level, an automatic sensitive gage which measures, records, if desired, and maintains the level of fluid in tanks, bins, kettles, or furnaces, is now being manufactured by General Glass Equipment.

Ideal for applications where physical contact with the material being measured is undesirable, the unit utilizes changes in differential air pressure to indicate and control the level of the fluid.

*General Glass Equipment Company.*

**(51) Explosion-Proof Hand Lamp.** For safe yet practical lighting in flammable atmospheres, such as in the interiors of fuel tanks during cleaning or painting operations, Crouse-Hinds has introduced an explosion-proof portable hand lamp.

Weighing less than 11 lb, the fixture (type EVH70) uses 150-w PAR-38, reflector-type spot and flood lamps, which produce a concentrated light pattern. The fixture's cone-shaped aluminum body is ridged with heat-dissipating fins.

*Crouse-Hinds Company.*

**(9) Teflon-Sealed Orifice Plate.** Daniel Orifice Fitting has developed an orifice plate sealing unit from Teflon.

Designed for use in Daniel Senior and Junior Fittings and Simplex Plate Holders, this seal unit is claimed to give perfect seal on both orifice plate and fitting seat.

The "TS" seal is a simple, two-piece unit that locks securely around the orifice plate with ring clips, and is recessed to receive Daniel Catalog 500 Orifice Plate. The plate can be removed by hand pressure alone.

*Daniel Orifice Fitting Company.*

**(52) Self-Service Installations.** Latest Granco Key-Control systems streamline operations. These automatic, self-service plant installations are said to provide foolproof recording of fuel consumption or loading—permit drivers to perform operation single handed.

A typical self-service installation consists of individual control boxes with a key for each customer, a meter, a pump, and valves for each product—all controlled by the customer's keys.

*Granberg Corporation.*

**(53) Pitot Tube.** An adjustable pitot tube to check the flow of corrosive and noncorrosive fluids is being manufactured by C-Mar.

Tube is available in stainless steel, monel, and other metals. Probe is readily adaptable to existing conventional meters measuring high flow rates. A safety lock permits the C-Mar pitot tube to be secured in any desired position providing operational safety especially when running a traverse.

*C-Mar Corporation.*

**(85) Bearing Temperature Monitor.** A multi-point bearing monitor, providing centralized and automatic temperature protection for bearings in large, stationary machinery installations, is announced.

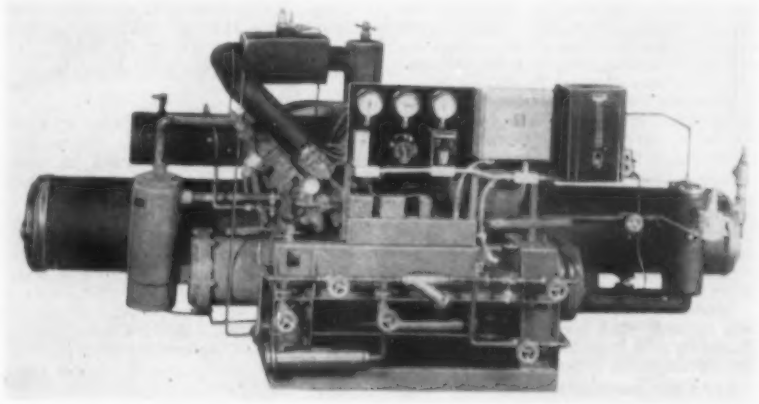
Controller is especially designed for use with such installations as diesel engines, stand-by electric generators, and petroleum pipe line pumping equipment.

*Tipp-Tronic, Inc.*

**(54) Packaged Liquid Coolers.** Employing the flooded refrigeration principle, the coolers are of special multipass design and may be used effectively for handling viscous or slurry-type liquids.

Package includes a complete refrigeration cycle, compressor, motor and starter, refrigerant controls, liquid cooler, etc. Units are available in a range of sizes from 5 to 100 hp. (Shown below.)

*Doyle & Roth Manufacturing Company, Inc.*

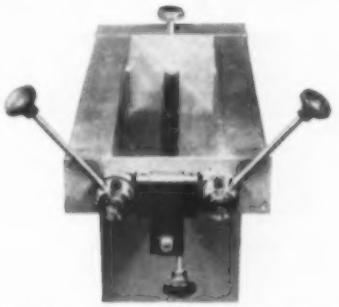


**(55) Handwheel Operator for Cylinder Actuators.** "Cono-Clutch" handwheel operator is available from Conoflow as an integrally mounted accessory for the company's standard line of Cylinder Conomotor actuators.

The "Cono-Clutch" hand operator affords immediate manual control in the event of air failure. It can be instantly thrown in and out of gear at any position of the stem travel. Clutching and declutching are accomplished simply by pulling or pushing a knob conveniently located on the face of the unit.

*Conoflow Corporation.*

**(56) Longitudinal Seam Welders.** New Series "B" Longitudinal Seam Welders is designed to weld the longitudinal seams



on various cylinders and flat sheets, and can be used equally well manually or fully automatic. The clamping action on the seam is performed manually and can be operated independently.

All models will handle work as small as 3-in. diam and as large as 30-in. diam. Machine is built in three standard sizes and three standard lengths, 18 in., 24 in., and 30 in. respectively.

*Reed Equipment Division, The Webb Corporation.*

**(87) Versatile Moisture Monitor.** Portable, low-cost instrument for accurately measuring minute quantities of moisture in gaseous mixtures is now available.

Called the Type 26-301 Moisture Monitor, it is expected to solve many problems encountered in pipe line operations, quality control, and process efficiency. It will measure water content accurately down to 1 ppm, and permit precise meter readings over the full-scale range of 0 to 1000 ppm. Output of the analyzer can be telemetered to a remote recorder for monitoring or control.

*Consolidated Electrodynamics Corporation.*

# NEW Literature

**For more information on items described here in brief, use the handy reply card and circle the corresponding numbers**

**(57) Pump Bulletin.** Dorr-Oliver announces publication of a new, two-color, 20-page, general bulletin, "Application Engineered," detailing the complete line of Dorr-Oliver pumps available to industry. It describes the distinctive characteristics, materials of construction, types, sizes and capacities of the six major types of Dorr-Oliver pumps for the chemical process and related industries.

*Dorr-Oliver Incorporated.*

**(58) Loading Hose and Fittings.** A four-page illustrated data sheet on its line of dock loading hose for handling gasoline and oil has been published by B. F. Goodrich. Publication reviews the complete line of dock loading hose and provides technical information on construction, specifications, and recommended uses.

*B. F. Goodrich Industrial Products Company.*

**(59) General Stock Catalog.** Fischer & Porter has published a 32-page catalog describing the company's products. New catalog, which includes prices, covers indicating, recording, controlling, and transmitting instruments for flow, pressure, and density.

*Fischer & Porter Company.*

**(60) Corrosion-Resistant Equipment.** A new 32-page catalog covering the corrosion-resistant plastic equipment of Haveg Industries is now available. The catalog, which marks the company's twenty-fifth anniversary, gives complete coverage to Haveg's wide range of synthetic resin formations.

*Haveg Industries, Inc.*

**(61) Stirrers, Mixers & Shakers** is the title of a new 16-page booklet. Bulletin describes Fisher Air-Driven, Electric, Glass, and Magnetic Stirrers; Stirring Electrodes, and others.

*Fisher Scientific Company.*

**(62) Vertical Pressure Filters.** Cochrane Publications 6319 and 6320 provide complete details on Cochrane Vertical Pressure Filters with positive foolproof filter control, for use in industrial plants.

*Cochrane Corporation.*

**(63) Control Transformer Line** — A new GE 32-page publication gives voltage ratings, frequency, frame size, weight, application, price, and specification data on autotransformers, control panel and machine-tool transformers.

Two-color bulletin contains accessory information, wiring diagrams, and voltage regulation curves for use in selecting the proper transformer for a given application.

*General Electric Company.*

**(64) Research.** A 12-page, two-color bulletin describes the Fluor research facilities that are now available to industry on a contract basis for the first time in the firm's 66-year history.

Services offered by this experienced outside research staff are explained, accompanied by case histories of recent research and development projects.

*The Fluor Corporation, Ltd.*

**(65) Water Analysis.** Solvay Process Division, Allied Chemical & Dye, has announced a revised, enlarged edition of its technical and engineering service bulletin, "Water Analysis."

*Solvay Process Division, Allied Chemical & Dye Corporation.*

**(66) Lubricated Plug Valves.** New 28-page catalog shows 100 per cent pipe area, venturi, round-port, and diamond-port Homestead Lubricated Plug Valves in a variety of metals for 150-lb steam working pressure, 200 lb oil-water-gas, and A.S.A. 150 and 300-lb classes.

Complete with engineering dimensions, this catalog also shows different types of power operators for valves, in addition to complete lines of lever-operated and worm and gear-operated valves.

*Homestead Valve Manufacturing Company.*

**(67) Totally Enclosed, Fan-Cooled Motors.** Latest design features of Allis-Chalmers totally-enclosed, fan-cooled motors in NEMA rerated ratings of ½ to 30 hp (Type GZ) and in non-rerated ratings of ½ to 100 hp (Type APZ) are described in a bulletin released by the company.

Besides cutaway views of the motor, the bulletin contains tables of ratings and dimensions as well as horsepower frame chart.

*Allis-Chalmers Manufacturing Company.*

**(68) Corrosion and Contamination-Proof Pipe Fabrication.** An eight-page brochure, featuring fabrication techniques and technical information on applications of Bart Lectro-Clad nickel-lined pipe and fittings, has been published by Bart Manufacturing.

Photomicrographs illustrate the pore-free and unique adherent characteristics of the pure nickel lining applied through the Bart Lectro-Clad Process, which, it is reported, affords the protection of pure nickel against contamination of product and corrosion, plus the economy and structural strength of seamless steel.

A separate section, complete with engineering drawings, is devoted to welding procedures and general fabrication techniques, demonstrating the ease with which Bart Lectro-Clad Pipe and Fittings can be fabricated or repaired in the field.

*Bart Manufacturing Corporation.*

**(69) Mechanical Packing.** Belmont Packing & Rubber has issued a 24-page condensed catalog on mechanical packings, which contains 246 types for every service in industry.

Featured are several recent packing developments, including the multi-purpose Bel-Vee V-Ring Packings, the Criss-Cross Braid Packing Series, Twisted Foil Packings for oil and distillate temperatures to 1000F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800F.

*The Belmont Packing & Rubber Company.*

**(70) Hydraulic Fan Drives.** De Laval Steam Turbine has released a bulletin that describes its hydraulic fan drive for air-cooled heat exchangers and cooling towers.

The 6-page, illustrated bulletin includes detailed information on the IMO motors and pumps and the worm gear reducers that make up the fan-drive unit. Also included in the bulletin are performance curves useful for selecting the right unit for specific applications.

*De Laval Steam Turbine Company.*

**(71) Gas Analyzer.** A 4-page brochure containing information on the Beckman RF Gas Analyzer is now available from Beckman Instruments.

The Beckman RF Gas Analyzer is described as a compact, rugged mass spectrometer which combines analytical versatility, simplicity, and low cost with ease of operation, portability, and performance. It can be used both as a continuous stream analyzer or routine laboratory instrument.

*Beckman Instruments, Inc.*

**(72) Miniature Bayonet Thermocouples.** Thermo Electric has issued a 10-page bulletin on its miniature bayonet thermocouples.

This bulletin contains a comprehensive set of instructions on the selection of the proper bayonet thermocouples and bayonet thermocouple adapters. It provides the user with a means of easily determining needed adapter length and thermocouple immersion length for a given hole depth—and a method of selecting one thermocouple for various hole depths by using different adapter sizes.

*Thermo Electric Company, Inc.*

**(73) Principal Products.** Colorado Fuel and Iron has made available an illustrated and indexed 70-page catalog describing the company's principal products.

Product listing is divided into broad classifications, which include semi-finished and hot-rolled steel, heavy and special steel items, rails and accessories, wire and wire products, Wickwire rope, overhead conveying equipment, industrial screens and wire fabrics, hardware products, springs and formed wires, processing belts, and various other product lines.

*The Colorado Fuel and Iron Corporation.*

**(74) Industrial Cooling Towers.** Baltimore Aircoil offers an 8-page catalog on its "MTI" Line of Industrial Cooling Towers.

The "MTI" Cooling Tower is designed especially for industrial applications where process water temperatures are critical and must be accurately maintained. Units have a capacity safety factor to guarantee positive performance at any condition.

These cooling towers are designed to meet nearly any approach or any range requirement in a single-stage unit (down to 2 deg approach—as high as 70 deg range).

*Baltimore Aircoil Company, Inc.*

**(75) Lift Trucks.** Latest trends in lift truck design are shown in a 12-page brochure of industrial lift trucks manufactured by Hyster. Illustrated and printed in two colors, the booklet is designed for quick reference of 25 different Hyster industrial truck models ranging in capacity from 1000 to 30,000 lb.

*Hyster Company.*

# MAJOR PIPELINES EVERYWHERE

## are served better by the very best...
## Walworth Lubricated Plug Valves

Walworth Cast Steel Lubricated Plug Valves enjoy a long record of successful service on pipelines the world over. In design, construction and performance they stand unsurpassed.

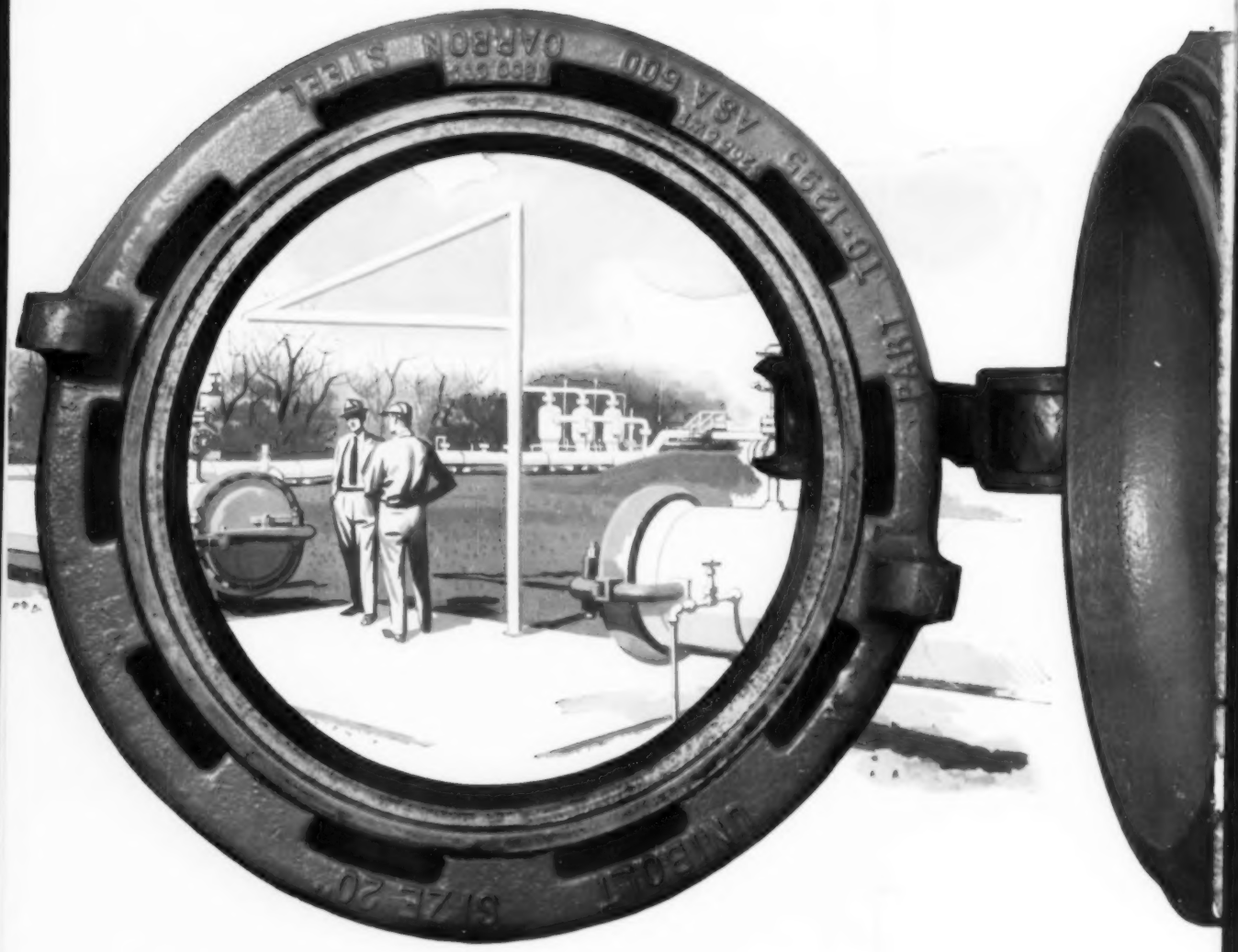
Other Walworth products include Gate, Globe, Angle and Check Valves in a wide range of types and sizes for the oil and gas industries. Sold by distributors in principal centers throughout the world.

# WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M & H VALVE & FITTINGS CO.
SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

## THE MODERN VIEWPOINT ON SCRAPER TRAPS



SELF-SEALING GASKET — made of Hycar (oil and gas resistant rubber) — is the final answer to scraper trap leaks. Its lipped design makes it self-sealing under line pressure. The coupling cannot be over-tightened to the extent of damaging the gasket or the coupling itself.

# UNIBOLT

No threads to gall or freeze . . . No leaky seals . . . No doubt about strength — it conforms to all codes . . . No multi-bolt flanges.

Release two bolts. Swing the trap open. Take the pig out or put the pig in. Close the trap and tighten two bolts. That's just how simple and easy it is to operate a UNIBOLT Scraper Trap. An over-size barrel (slightly larger than the o. d. of the pig) makes it equally easy to start a pig. Line pressure does the heavy work.

Pipeliners everywhere are using UNIBOLT closures and couplings for scraper traps, blowdowns, strainers, mist removers and other large diameter pressure vessels.

**THORNHILL CRAVER CO.**
**P. O. BOX 1184 HOUSTON, TEXAS**

# PIPE LINE DEVELOPMENTS ★ ★ ★

***Roundup of Planned and Proposed Construction***

The following tables list the company, mileage, pipe size, and location of proposed pipe line projects — crude, products, and natural gas — reported to *The Pipeline Engineer*. Company addresses are given when known.

## CRUDE LINES

| Name of Company | Miles | Size | Location |
|---|---|---|---|
| **Interprovincial Pipe Line Company**<br>Toronto 1, Ontario, Canada | 151<br>32.6 | 20<br>24 | Sarnia to Fort Credit, Ontario<br>Regina, Saskatchewan, to Cromer, Manitoba |
| **Lakehead Pipe Line Company, Inc.**<br>Toronto 1, Ontario, Canada | 80 | 26 | Loop from Clearbrook, Minnesota, to Superior, Wisconsin |
| **North-West Oil Pipelines Company** | 210 | — | Wilhelmshaven, on the North Sea, to industrial Ruhr area of West Germany |
| **Northwest Pipe Line Corporation**<br>Salt Lake City, Utah | 350 | 8 | Four Corners area to Salt Lake City, Utah |
| **Offshore Gathering Company**<br>Houston, Texas | 364 | 20 | Gulf of Mexico from Sabine Pass to Mississippi River |
| **Pasotex Pipe Line Company**<br>El Paso, Texas | 127.5 | 20 | New loop on system from Wink to El Paso, Texas |
| **Rangeland Pipe Line Company**<br>Calgary, Alta., Canada | 450 | — | Sylvan Lake Area to Sundre (Central Alberta) |
| **Royal Dutch Shell Group and Others**<br>The Hague, Netherlands | 870 | 30 | Marseille, France, to Rotterdam, Holland, and Antwerp, Belgium |
| **Royal Pipe Lines, Ltd.**<br>Regina, Saskatchewan, Canada | 288 | Var. | Cantuar area fields to Glenavon |
| **Shell-Standard of California** | 600 | 14 | Four Corners Area to Los Angeles |
| **Sinclair Pipe Line Company**<br>Independence, Kansas | 150 | 20 | Teague to Houston, Texas |
| **Socony Mobil Oil Company de Venezuela and Sinclair Oil & Refining Company** | 211 | 20 | Silvester field near Barines to Puerto Cabello, Venezuela |
| **Tecumseh Pipe Line Company**<br>Independence, Kansas | 190 | 20 | East Chicago, Indiana, to Cygnet, Ohio |
| **Trans-Border Pipe Line Company** | 110 | — | Skagway, Alaska, to Whitehorse, Yukon Territory |

## PRODUCTS LINES

| Name of Company | Miles | Size | Location |
|---|---|---|---|
| **El Paso Natural Gas Company**<br>El Paso, Texas | 96.0 | 8 | Gallup to Blanco Plant, New Mexico |
| **Equitable Gas Company and Subsidiaries**<br>Pittsburgh, Pennsylvania | 100 | 4–5 | Maytown, Kentucky, to Institute, West Virginia |
| **Hydrocarbons Pipelines, Ltd.**<br>Winnipeg, Manitoba, Canada | 800 | 6-8 | Edmonton to Fort William, Canada |
| **North Atlantic Treaty Organization** | 275 | 2–8 | In northeastern France, between points of Langres, Mirecourt, Strasbourg, Metz, Phalsbourg and Deux Ponts |
| **Northwest Pipeline Corporation**<br>Salt Lake City, Utah | 350 | 8 | Four Corners area to Salt Lake City, Utah |
| **Ohio Oil Company**<br>Findlay, Ohio | —<br>— | —<br>— | Common carrier line from Wood River, Illinois, to Chicago<br>Connecting line from Robinson, Illinois, refinery to new line |
| **Service-Continental-Sinclair-Phillips** | 550 | — | Salt Lake City, Utah, to Spokane, Washington |
| **Southern Pacific Pipe Lines, Inc.**<br>Los Angeles, California | 315 | 6–10 | Richmond, California, to Fallon, Nevada |
| **Texas Eastern Transmission Corporation**<br>Shreveport, Louisiana | 1168 | 16–20 | Conversion of "Little Inch" between Beaumont, Texas, and Moundsville, West Virginia |
| **Union Oil Company of California** | 815 | — | Shale Oil Plant, Rifle, Colorado, to Los Angeles area |
| **Winnipeg & Central Gas Company**<br>Winnipeg, Manitoba, Canada | 210 | 6 | U. S.-Canadian border to Winnipeg |

## GAS LINES

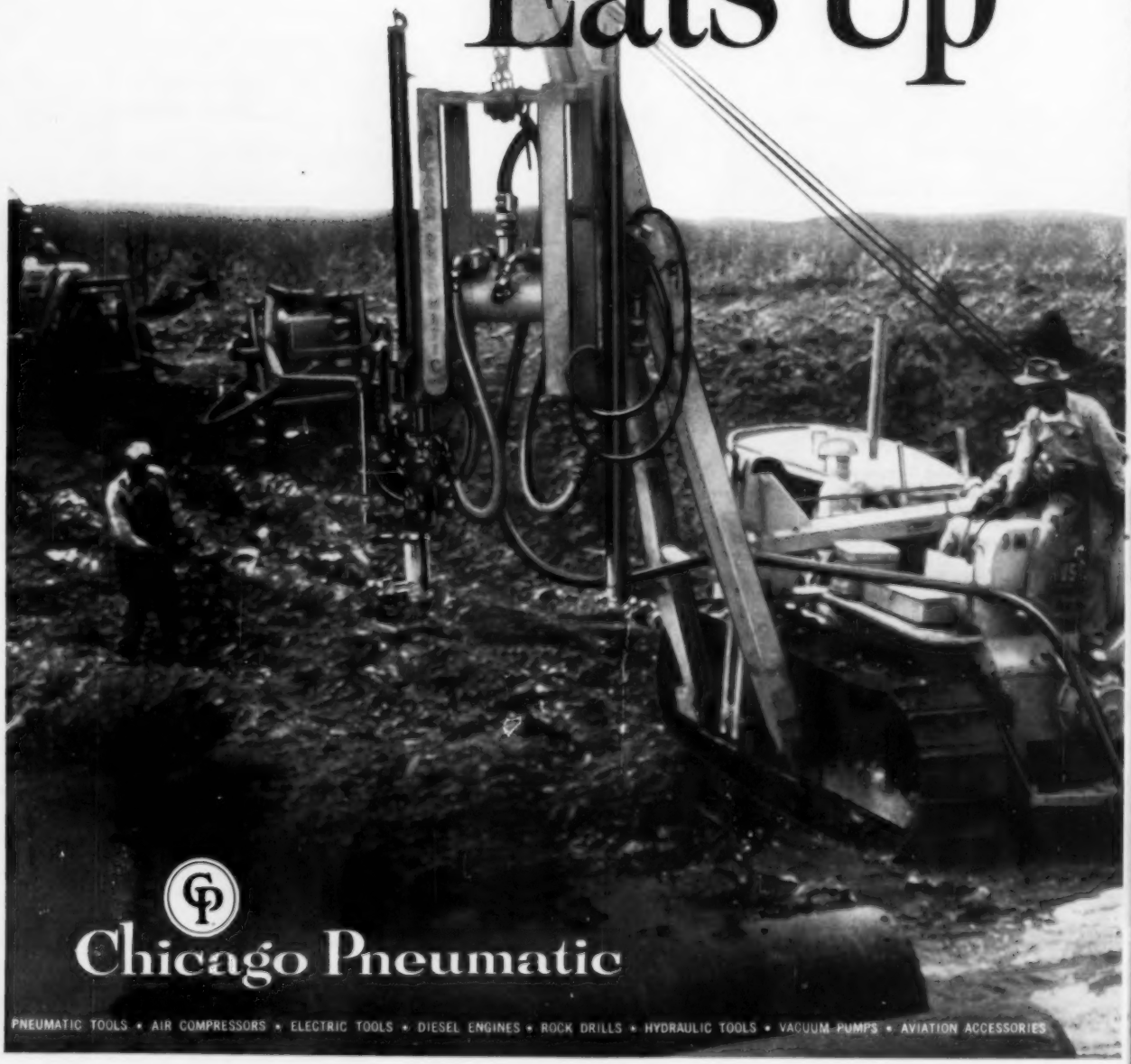
| Name of Company | Miles | Size | Location |
|---|---|---|---|
| **Andes Pipeline Corporation** | 500 | 12 | Villamontes, Bolivia, to Antofagasta, Chile |
| **Carolina Natural Gas Corporation**<br>Hickory, North Carolina | 185 | 2–12 | Additions in North and South Carolina |
| **Cities Service Oil Company**<br>Bartlesville, Oklahoma | 70 | — | Gas gathering system on the Roberts Ranch, Midland, Texas |
| **Coastal Transmission Corporation**<br>Dallas, Texas | 562<br>272 | 22–26<br>Var. | McAllen, Texas, to Baton Rouge, Louisiana<br>Gathering lines in Rio Grande Valley, Texas |
| **Colorado Interstate Gas Company**<br>Colorado Springs, Colorado | 345<br>100<br>50 | 30<br>24<br>22 | Kit Carson, Colorado, to Beatrice, Nebraska<br>Springfield to Pueblo, Colorado<br>Hooker to Mocane and Laverne fields, Oklahoma |

gasket or the coupling itself.

P. O. BOX 1184 HOUSTON, TEXAS

CP "Power Vane" Rotary Compressors are available in capacities of 125, 210, 365, 600 and 900 cfm.

# "Eats Up"



Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Team up the dependable CP "Power Vane" Rotary Compressor with the GTD-300 Trenchdril. Add your own side boom tractor and you've got a combination that's really great when the going gets tough! For more details call your nearby CP equipment dealer or write direct to *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

# Tough Sections

## *. . . and comes back for more!*

| Name of Company | Miles | Size | Location |
|---|---|---|---|
| | 24 | 24 | Greenwood to Panhandle-Kit Carson loop |
| | 109 | 20 | Loop from Fourway, Texas, to Springfield, Colorado |
| | 106 | 24 | Loop from Springfield to Kit Carson, Colorado |
| | 10 | 16 | Keyes field, Oklahoma, to mainline |
| | 6 | 10 | Tablerock field, Wyoming, to mainline |
| | 48.0 | 4–16 | Additions in Mocane field, Oklahoma |
| | 12.0 | 12–22 | Additions in Texas Panhandle fields |
| **El Paso Natural Gas Company** El Paso, Texas | 83.8 | 34 | Loops to San Juan mainline extending from San Juan County, New Mexico, to Topock, Arizona |
| | 20.5 | 30 | Loops to existing Permian-San Juan mainline from Bluewater station to San Juan mainline in McKinley County, New Mexico |
| | 8.3 | 26 | Loops to California mainline in Yuma County, Arizona |
| | 28.5 | 30 | Field transmission line in San Juan Basin, New Mexico |
| | 78.8 | 18 | Field line from Carson County, Texas, to Moore County, Texas |
| | 22.5 | 20 | South Andrews field booster station to plant |
| | 8.5 | 16 | Shell plant to Goldsmith station |
| **Houston Texas Gas & Oil Company** Houston, Texas | 961 | 12-30 | Baton Rouge, Louisiana, to Miami, Florida, laterals |
| **Kansas-Nebraska Natural Gas Company** Phillipsburg, Kansas | 61.3 | var. | Gathering lines from Camerick field to Liberal, Kansas |
| **Kansas-Nebraska Natural Gas Company, Inc.** Hastings, Nebraska | 10 | 10 | Grand Island to Fullerton, Nebraska |
| | 10 | 8 | Loop from Grand Island to Fullerton, Nebraska |
| | 11.5 | 12 | Replacement from Scott City to Oakley, Kansas |
| | 1.2 | 6 | Additions to system in Nebraska |
| | 9 | 8 | Lexington to Central Nebraska Public Power Electric Plant |
| | 14 | 16 | Replacement from North Platte to Maxwell, Nebraska |
| **Michigan Wisconsin Pipe Line Company** Detroit, Michigan | 31 | 4-6 | Looping in Michigan and Indiana |
| **Midwestern Gas Transmission Company** | 1112 | 12–24 | Mainline from U. S.-Canadian border near Emerson, Manitoba — Noyes, Minnesota, to Portland, Tennessee |
| | 648 | 3–18 | Laterals of mainline to serve communities in Minnesota, North Dakota and Wisconsin |
| **Natural Gas Pipeline Company of America** Chicago, Illinois | 349 | 20–26 | Jack and Wise counties to Fritch, Texas |
| | 38 | 36 | Joliet to Elgin, Illinois |
| | 405 | 36 | Beaver County, Oklahoma, to Joliet, Illinois (loops) |
| | 25 | — | Gathering line from Quinduna field, Roberts County, Texas, to point on existing line |
| | 91 | 30 | Loops in Nebraska, Kansas, Oklahoma |
| **Northern Natural Gas Company** Omaha, Nebraska | 28 | 24 | Ogden to Redfield storage area, Iowa |
| | 168 | 20 | St. Paul-Minneapolis to Duluth, Minnesota, and Superior, Wisconsin |
| | 307 | Var. | Branch lines in South Dakota, Minnesota, Iowa and Wisconsin |
| | 100 | 20–24 | Savannah Creek field, Alberta, to Alberta-Montana border near Cardston, Alberta |
| **Northern Plains Natural Gas Company (subsidiary of Northern Natural Gas Company)** Omaha, Nebraska | 1100 | 26 | Alberta-Montana border to Minneapolis, Minnesota |
| **Offshore Gathering Company** Houston, Texas | 364 | 30 | Offshore gas line in Gulf of Mexico from Sabine Pass to Mississippi River |
| **Pacific Gas & Electric Company** San Francisco, California | 200 | 12 | Glenn and Tehama counties to Eureka and Arcata, California |
| **Pacific Lighting Gas Supply Company** Los Angeles, California | 80 | 30 | Coles Levee to Newhall |
| | 2.1 | 16–20 | Potrero to Newhall |
| | 2.8 | 16 | Lines in East Whittier |
| **Tennessee Gas Transmission Company** Houston, Texas | 100 | — | New gathering lines in Texas and Louisiana |
| | 557 | 30 | Mississippi River Delta south of New Orleans to Portland, Tennessee |
| | 120 | 12,20,26 | Kinder, Louisiana, south 53 miles into Gulf of Mexico |
| | 332 | 24–30 | Loops in Kentucky, West Virginia, Pennsylvania, Tennessee |
| | 76 | 24 | Coudersport, Pennsylvania, to Buffalo, New York |
| | 299 | var. | Adding to existing systems in Ohio, Pennsylvania, Kentucky, Texas and Louisiana |
| **Texas Eastern Transmission Corporation** Shreveport, Louisiana | 530 | 30 | Loops from Kosciusko, Mississippi, to Uniontown, Pennsylvania |
| | 45 | 24 | Provident City, Texas, to McAllen-Vidor line near Blessing |
| | 301 | 30 | McAllen to Vidor, Texas |
| | 141 | Var. | Supply laterals from South Texas area to McAllen-Vidor line |
| | 10 | 12 | Loop from Broadaxe Junction to Levick Street, Philadelphia, Pennsylvania |
| | 6 | 12 | Loop from Broadaxe Junction to Conshohocken, Pennsylvania |
| | 5 | 10 | South Plainfield to Highland Park, New Jersey |
| **Texas-Illinois Natural Gas Pipeline Company** Chicago, Illinois | 59 | 20 | Joliet to Volo, Illinois |
| **Trans-Canada Pipe Lines, Ltd.** Calgary, Alberta, Canada | 1675 | 30–34 | Winnipeg to Montreal and laterals |
| **Trans-Carolina Pipe Line Corporation** Raleigh, North Carolina | 840 | 2–18 | New line between Moore, South Carolina, and Morse, North Carolina with laterals |
| **Transcontinental Gas Pipe Line Corporation** Houston, Texas | 251 | 24,30,36 | Loops on system |

***Through Mountainous Terrain, Dust Storms and Weather Extremes...***

From a point on Colorado's Cheyenne Mountain, the microwave beam is relayed over mountains and prairies alike in its 230-mile swing to gas fields in Kansas and Oklahoma.

# RCA Microwave's Dependability

## has justified Colorado Interstate Gas Co.'s choice for pipeline communications system

When Colorado Interstate engineers studied communication facilities to connect home office with pipeline compressor stations and with gas-producing fields in Kansas and Oklahoma, they considered wire line, common carrier and microwave. They chose RCA Microwave.

According to W. I. Blount, Superintendent of Dispatching and Communications, "RCA Microwave offered many advantages. It provided relatively easy maintenance, static-free operation and was economically equal to wire line or common carrier. And the more numerous the channels, the cheaper by comparison it became.

"In addition, such a microwave system made it possible to integrate into our already established VHF radio system more stations and mobile units and thus increase the efficiency and scope of our radio system. It offered almost unlimited future possibilities, such as telemetering channels, facsimile, teletype, additional voice channels, remote control of unattended stations and a service channel—all at a relatively small cost."

Only RCA MICROWAVE systems provide so many advanced engineering features. For example, single sideband suppressed-carrier frequency-division multiplex is used exclusively to meet high standards of dependability. Frequency is controlled from the terminal through the entire system.

*Microwave specialists will be glad to answer any questions and plan your installation. Mail coupon for further particulars on use of Microwave in utilities, pipelines, turnpike and other applications.*

**RCA MICROWAVE**

**POINT-TO-POINT COMMUNICATION**

**RADIO CORPORATION of AMERICA**
COMMUNICATIONS EQUIPMENT
CAMDEN, N. J.

**Radio Corporation of America**
**Communications Equipment, Dept. N-127, Building 15-1, Camden, N. J.**

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NAME _____ TITLE _____

COMPANY _____

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CITY _____ ZONE _____ STATE _____

☐ Have an RCA Representative get in touch with me.

# Interested in pipe protection?

## ...HERE'S A SPECIAL MESSAGE FOR YOU!

Telefax **WESTERN UNION** Telefax

TO THOSE CONCERNED WITH
MAXIMUM PIPE PROTECTION

NEW HILL. HUBBELL PLANT AT HAMMOND. INDIANA NOW OPERATING. DOUBLE FORMER PLANT CAPACITY. NEWEST ELECTRONIC CONTROLS. LARGER SKILLED STAFF ASSURE MAXIMUM LIFE EXPECTANCY FOR HILL. HUBBELL WRAPPED PIPE. HUGE NEW STORAGE YARDS FOR PIPE STOCK-PILING. THROUGH RAIL RATE PROTECTION ON MOST ROADS. SPECIFY HILL. HUBBELL. YOUR NEXT JOB.

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**Electronic production control...another "first" by**

# HILL·HUBBELL & COMPANY

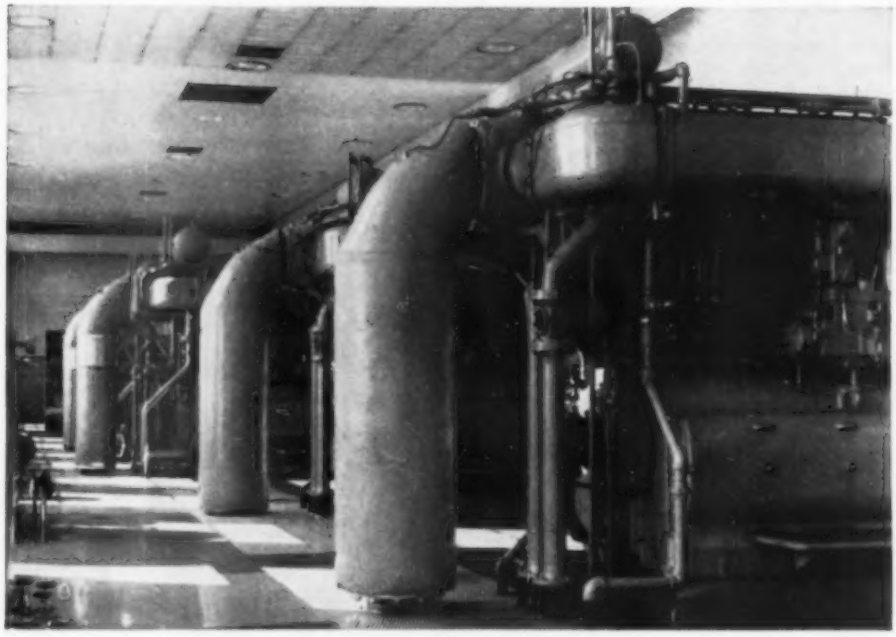
FACTORY APPLICATORS OF COATINGS AND WRAPPINGS

**DIVISION OF GENERAL PAINT CORP. • 3091 MAYFIELD ROAD, CLEVELAND 18, OHIO**

## *Another Pipe Line Company Reports*

# 2 to 3 times more horsepower hours

**. . . after installing Koppers Conformable Oil Rings**



Koppers Porous Chrome* Rings. Porous chrome surface holds and distributes oil during break-in. Seats quickly. This chrome prevents grit from embedding in ring surface. Prevents cylinder wall scratching. Reduces wear 50%. Last 4 times longer than other rings.

Koppers Conformable Ring maintains constant unit pressure for positive oil control. Conforms readily to meet cylinder distortion because flexible cast iron member is pressed outward by abutment type spring which exerts uniform radial pressure around entire circumference.

*Van der Horst Process

Here's proof that Koppers Piston Rings increase operating efficiency.

**Prior to using Koppers Conformable Oil Rings, a pipe line company reported average oil consumption as approximately 3500 to 4000 horsepower hours per gallon. Now they are getting 2 to 3 times that much.**

In addition to this large saving in oil consumption, they find they get longer periods of satisfactory operation between overhauls.

As a result, this pipe line company has adopted Koppers Piston Rings as standard equipment on all their 12½" x 13" turbo-charged engines.

Does this suggest possible savings in your operation? Less oil consumption? Less down time, lower labor costs? Then investigate Koppers Porous Chrome* and Conformable Oil Rings. And install them next time you have a piston ring replacement job.

Write for special assistance from our experienced technical staff. No obligation, of course . . . . and mail the coupon for special conformable ring folder.

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**AMERICAN HAMMERED**
*Industrial Piston Rings*

**METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • Baltimore, Maryland**
This Koppers Division also supplies industry with Fast's Couplings, Aeromaster Fans, Koppers Electrostatic Precipitators and Gas Apparatus.
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Gentlemen: Please send me full information on your Conformable Oil Ring.

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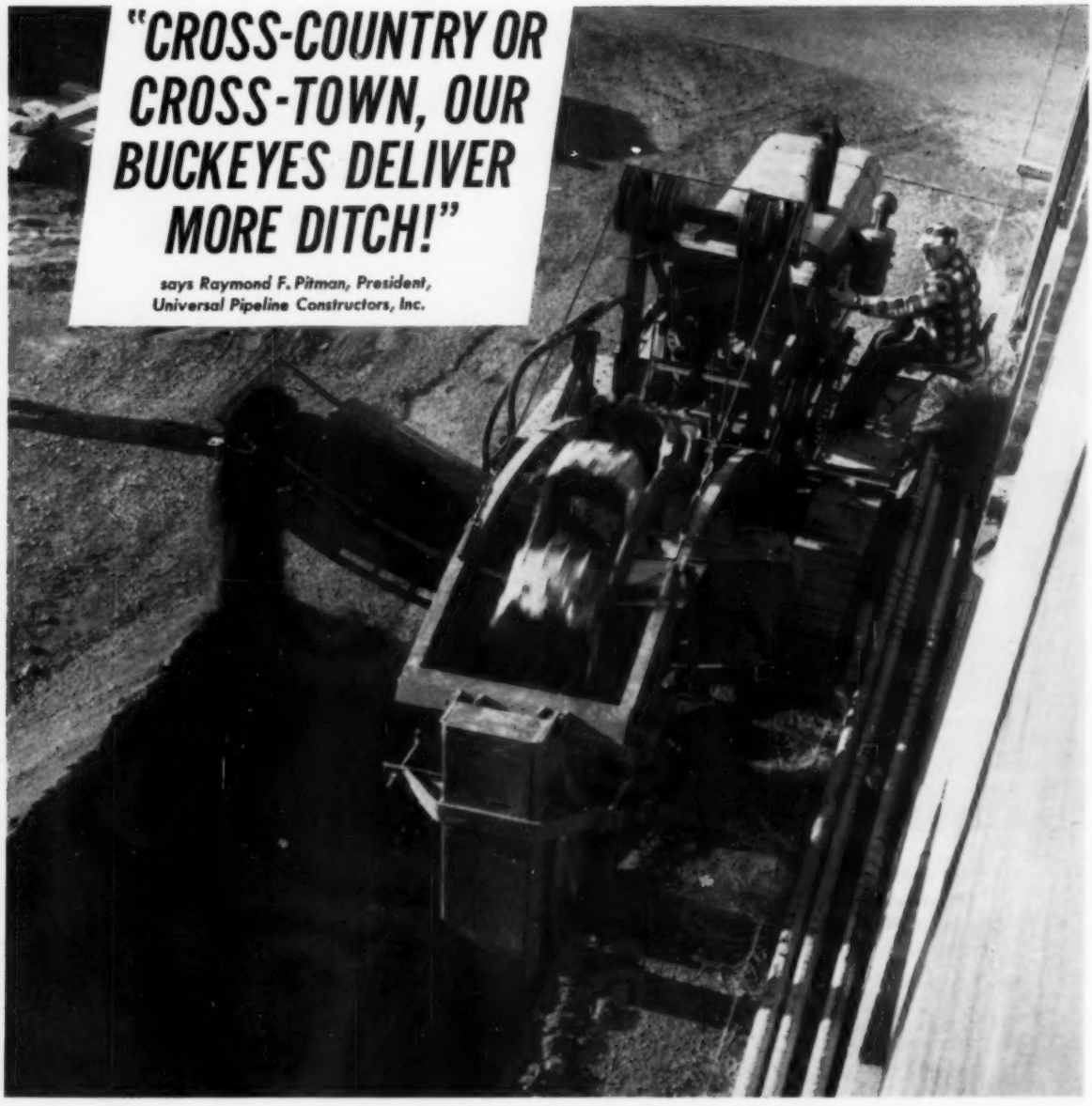
City ..... Zone ..... State .....

# "CROSS-COUNTRY OR CROSS-TOWN, OUR BUCKEYES DELIVER MORE DITCH!"

*says Raymond F. Pitman, President, Universal Pipeline Constructors, Inc.*



"We chose six Buckeye ditchers to dig the 1,200,000 feet of ditch called for in our contract with Intermountain Gas Company," reports Mr. Pitman, "and whether it's been rugged cross-country work or narrow-alley city ditching, these machines have been more than a match for any conditions we've met!"

Gar Wood-Buckeye has developed many features that insure uninterrupted production despite changing conditions. "Because wheel hoist and conveyor drive are hydraulic and work independently of each other," says Pitman, "we can dig a straight-line ditch exactly where we want it . . . place spoil on either side and at any distance from the machine . . . work over and around existing pipes and lines without stopping forward travel. And, all adjustments are made right from the operator's seat."

"In the 70,000 feet we've already dug," continues Pitman, "these Buckeye ditchers have really proved themselves. The 308's have kept production high on overland segments. Our 305's have given us the accurate control needed for close-quartered city jobs and have turned in dependable performance on in-between-sized jobs!"

Find out for yourself how much more profitable ditching can be with an advanced Gar Wood-Buckeye machine. Call your Gar Wood-Buckeye dealer, or write direct to: Customer Service Dept., Gar Wood Industries, Inc., Wayne, Michigan.

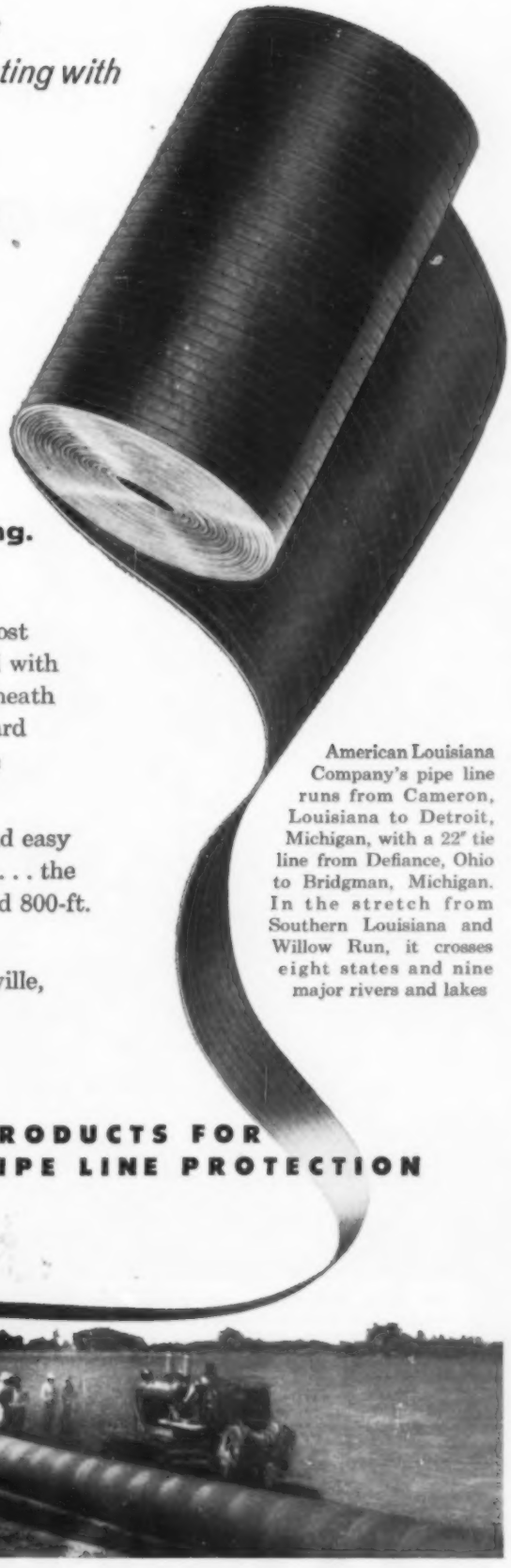
## GAR WOOD INDUSTRIES, INC.

**Wayne, Michigan • Findlay, Ohio**

*American Louisiana Pipe Line protects approximately 600 miles of its pipe coating with*

# Johns-Manville Transhield®

## Asbestos Pipe Line Felt



**Permits high-speed wrapping... assures effective protection for coating.**

Transhield gives high value for a reasonable cost . . . made of tough, long-life asbestos reinforced with parallel glass yarns . . . it forms a continuous sheath between the enamel coating and the soil to guard against soil stress and give long life to the pipe line coating.

Contractors like Transhield's light weight and easy application . . . it speeds up coating operations . . . the high tear strength (a knife is used to cut it) and 800-ft. rolls lower construction costs.

For further information write to Johns-Manville, Box 14, New York 16, N.Y.; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.

American Louisiana Company's pipe line runs from Cameron, Louisiana to Detroit, Michigan, with a 22" tie line from Defiance, Ohio to Bridgman, Michigan. In the stretch from Southern Louisiana and Willow Run, it crosses eight states and nine major rivers and lakes

**Johns-Manville** PRODUCTS FOR PIPE LINE PROTECTION

*For the petroleum industry...*

# There's MORE

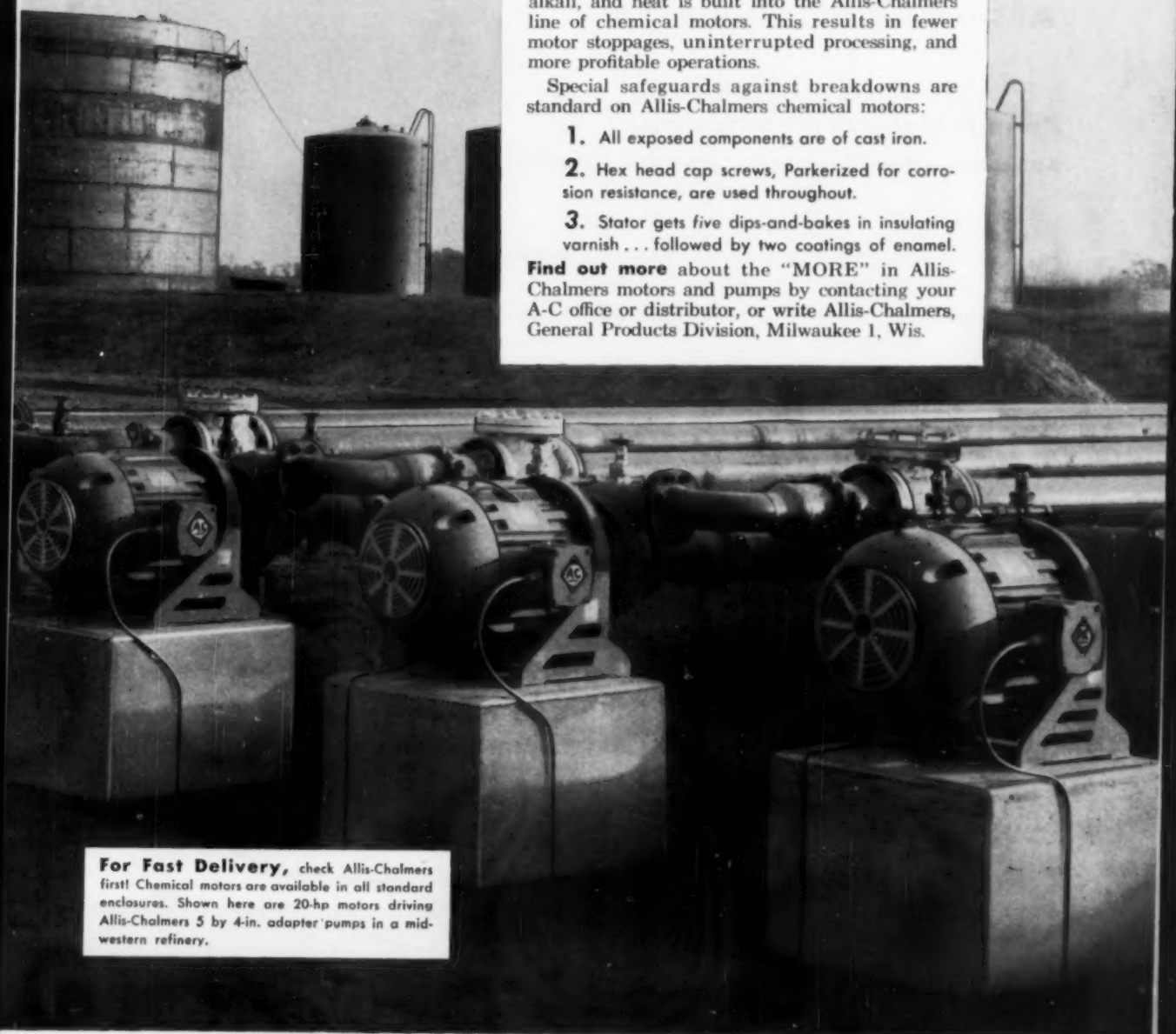
## continuous processing with Allis-Chalmers chemical MOTORS and PUMPS

**Maximum protection** against moisture, acid, alkali, and heat is built into the Allis-Chalmers line of chemical motors. This results in fewer motor stoppages, uninterrupted processing, and more profitable operations.

Special safeguards against breakdowns are standard on Allis-Chalmers chemical motors:

1. All exposed components are of cast iron.
2. Hex head cap screws, Parkerized for corrosion resistance, are used throughout.
3. Stator gets *five* dips-and-bakes in insulating varnish . . . followed by two coatings of enamel.

**Find out more** about the "MORE" in Allis-Chalmers motors and pumps by contacting your A-C office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.



**For Fast Delivery,** check Allis-Chalmers first! Chemical motors are available in all standard enclosures. Shown here are 20-hp motors driving Allis-Chalmers 5 by 4-in. adapter pumps in a mid-western refinery.

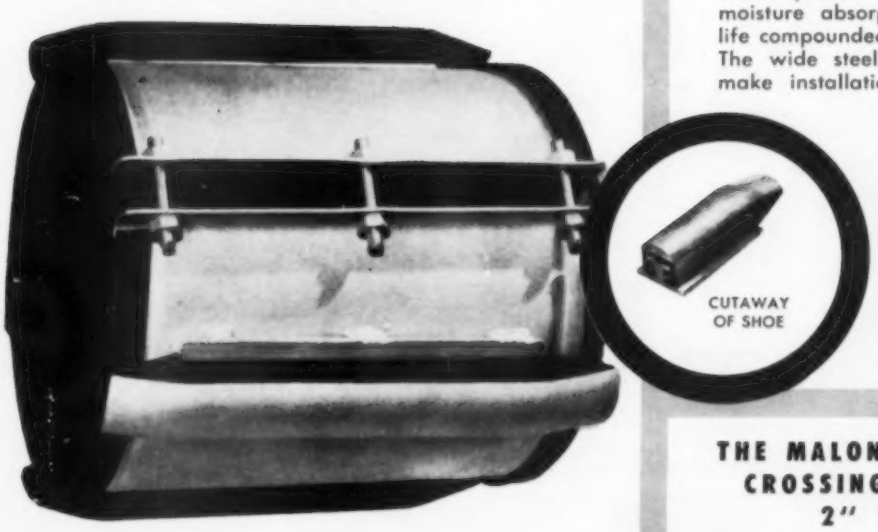
# ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-3168

# MALONEY INSULATORS for any job

LARGE

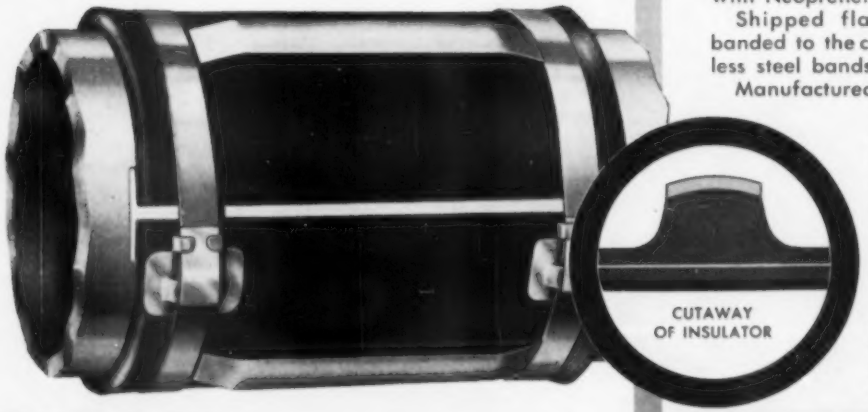



### THE MALONEY MODEL 55 CROSSING INSULATOR FOR ALL SIZES OF PIPE

These insulators have superior insulation qualities because of the low moisture absorption and the long life compounded into the Neoprene. The wide steel, sled type runners make installation easy. The extra wide band affords a positive grip.

Bonded metal-to-Neoprene-to-metal, the runner insulates and also permits flexibility to compensate for pipe shifting and acts as a shock absorber to prevent damage due to sudden heavy loads.

or small




### THE MALONEY MODEL 56 CROSSING INSULATOR 2" TO 12"

Manufactured with Neoprene, which is vulcanized to steel band core and to the rounded steel runners, there is no place to "short-out" between the casing and the carrier line. The steel core is completely surrounded with Neoprene.

Shipped flat, the Insulator is banded to the carrier pipe with stainless steel bands.

Manufactured in sizes from 2" thru 12", it can be used either on installations where there is only one nominal pipe size difference or on installations having a larger differential.

This is the Insulator designed and manufactured to give you the best job at a competitive price.

SINCE 1932—
PRECISION IN RUBBER—
METAL—PLASTICS

"Something from the Irishman"

**F. H. MALONEY** *Company*

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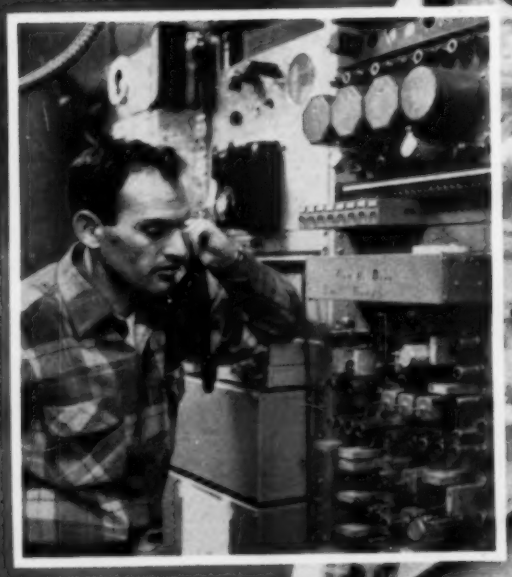
# Bonneville depends on



# Microwave FOR COMMUNICATIONS TELEMETERING REMOTE CONTROL and VHF CONTROL

## *a 600-mile microwave system requiring greatest reliability*

There's no icing of these microwave dishes—*not even in the snowbound Northwest*—thanks to a newly developed Philco antenna cover, Thermo-Microdome! Complete de-icing . . . a *must* for reliability in any communications system . . . but only one of many features, including diversity, in the microwave installation of the Bonneville Power Administration.

Here are a few of Bonneville's microwave facilities: An extensive telemetering system in Portland, Oregon, control center for the Federal Columbia River generating and transmission system, gives instantaneous readings of voltage, frequency and power produced by five distant dams. Sixteen telemetering channels are carried by a single voice channel for 28 hops—one over 60 miles long. Every station is equipped for ten automatic functions including fault reporting, standby-switching and equipment "status check"!

Philco offers a "complete microwave package": Every item of equipment you may need; experienced system planning; installation and service after the sale. Write Department PE for full details.

Bonneville's custom-built Augspurger microwave station. Durable shelters to house microwave and multiplex equipment, as well as towers, antennas, and reflectors, are available in the Philco product line.

Beside utilities such as the Bonneville Power Administration, Philco has installed extensive systems for leading pipelines, turnpikes, railroads, telephone companies and governmental agencies.

PHILCO—*Pioneer and World Leader in Microwave*

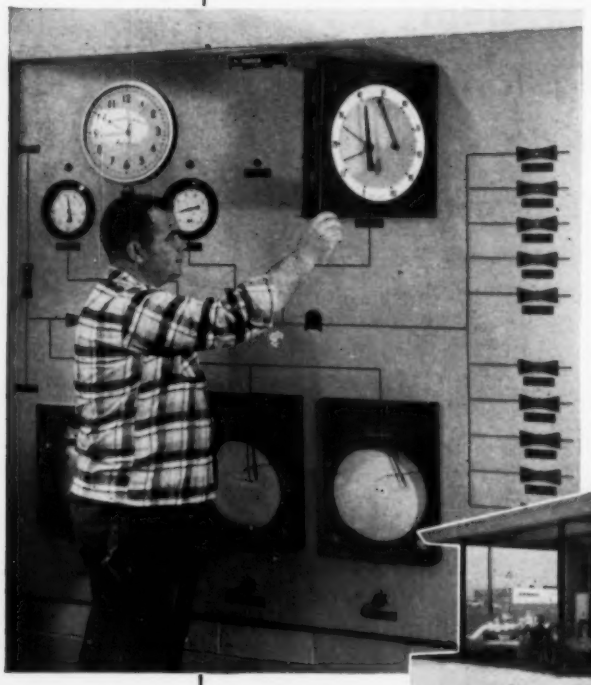
# PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44 PENNSYLVANIA

PHILCO Famous for QUALITY

**In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario**

# Every station on the Badger Pipeline uses Brown instruments



*An operator checks a Brown ElectroniK temperature recorder at the Des Plaines metering station of the Badger Pipeline Co. Also on the panel are interlocked Brown flow and pressure controllers, and a Nelson specific gravity meter, which transmits to an ElectroniK strip chart recorder. A dispatcher at this station supervises product flow for the entire system.*

*Des Plaines, Ill. metering station of the Badger Pipeline Company. The company is owned jointly by Sinclair Pipeline Co., Cities Service Oil Co. (Del.), The Texas Co., and the Pure Oil Company.*

AT metering stations, at pumping stations . . . all along the Badger Pipeline . . . Brown instruments keep close watch over temperature, pressure and flow. The Badger Pipeline system serves an area surrounding metropolitan Chicago and northwest to Rockford, Ill. and Madison, Wis.

At the Des Plaines metering station shown above, *ElectroniK* recorders provide accurate temperature and specific gravity information. A Pressure Controller is interlocked with a Flow Controller to position the station control valve. Flow controller input is received from a mercuryless *Differential Converter* transmitter.

Accuracy, sensitivity, and "built-to-take-it" construction make Brown instruments ideally suited for pipeline operations everywhere.

For a discussion of your own pipeline applications, call your local Honeywell sales engineer . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*

Various sections of the 1000 mile American Louisiana Pipeline are coated with three types of coal tar enamels: Bitumastic® No. 2 Enamel for mild climates, Bitumastic 70-B Enamel for cold locales, and Bitumastic Hi-Melt Enamel for the hot portions after compressor stations.

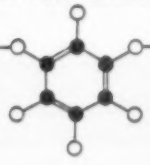
# Most of the big pipeline jobs are protected with **COAL TAR ENAMEL**

No doubt about it, coal tar enamel is getting the nod from men responsible for corrosion prevention on today's pipelines. They know from *experience* that coal tar is the best investment for long-term protection of underground lines.

Coal tar enamel has inherent characteristics that explain its unique superiority as a pipeline coating. First and foremost is its water-resistance: tests have proved that coal tar enamel resists water better than any other commonly-used coating material.

Naturally, this excellent resistance to the absorption of water makes coal tar a more effective insulating material, an important factor in cost where complementary cathodic protection is used. Its other qualities of chemical inertness and toughness enable coal tar to resist deterioration from the action of soil chemicals and soil stresses.

Only Koppers produces Bitumastic coatings—a complete line of coal tar enamels to meet every pipelining need, from hot-line coating at compressor stations to sub-zero conditions. Write or call your nearest Koppers office; a representative will be glad to give you the complete story on effective pipeline protection with Bitumastic Enamels.



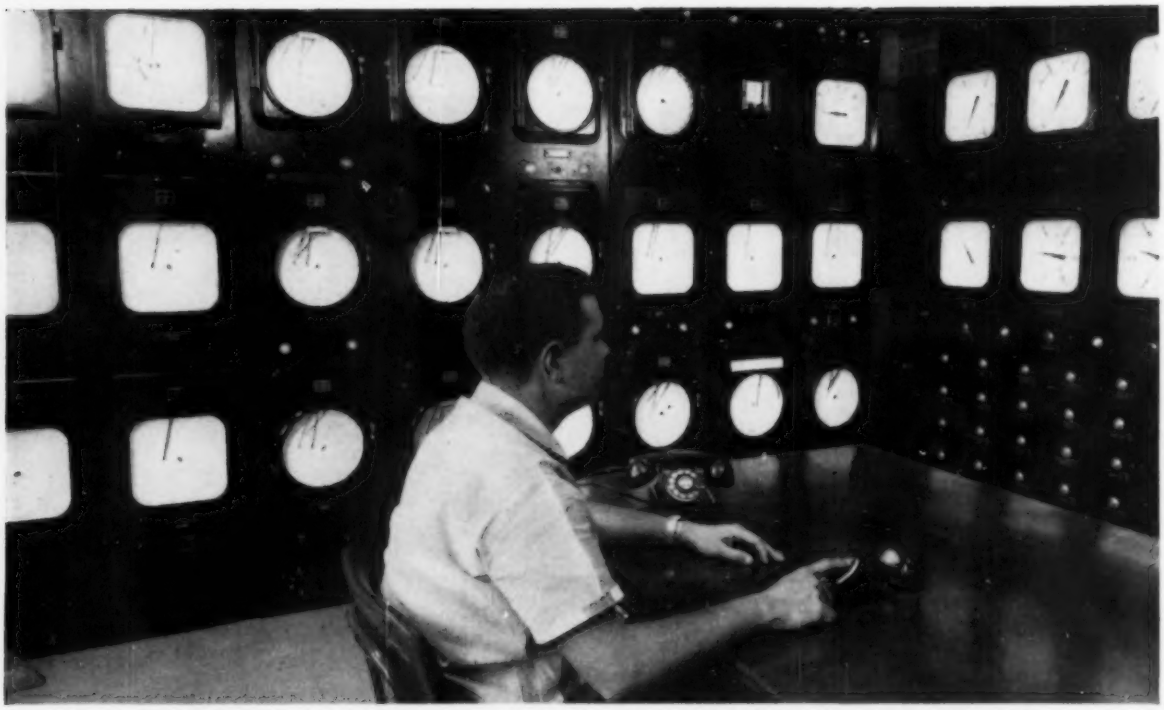
*This is a representation of the aromatic benzene ring, heart of coal tar's molecular structure, and key to its unexcelled performance as a pipeline coating.*

KOPPERS

**BITUMASTIC**

REG. U. S. PAT. OFF.

**COAL TAR ENAMELS**



Bell System *selective calling* is used by the dispatcher of Mississippi Valley Gas Co. By flipping a switch, dialing the number of a distant metering point and reading a meter, he knows the pressure, flow and temperature at any of the company's 21 field points.

# "When you're sure how much you have, you know how much you can sell"

***J. H. Lambdin, Vice President—Operations, Mississippi Valley Gas Company***

Bell System telemetering channels provide data on which Mississippi Valley Gas Co. can regulate flow to within 1% of a 60,000 MCF supplier contract limit. With this up-to-the-minute picture of the system, the company is better able to sell more gas.

This system, first of its kind in the country, was designed especially for Mississippi Valley. Used only to read remote meters now, it can be adapted to perform actual control functions at distant points.

• • •

***If you'd like to have faster, more efficient communications, call your Bell Telephone representative. He will be glad to study your needs.***

**BELL TELEPHONE SYSTEM**

PRIVATE LINE TELEPHONE • PRIVATE LINE TELETYPEWRITER

CHANNELS FOR: DATA TRANSMISSION • TELEMETERING • REMOTE CONTROL
TELEPHOTOGRAPH • CLOSED CIRCUIT TV



FOR FURTHER INFORMATION ON ADVERTISED PRODUCTS, SEE READER SERVICE CARD

PIPELINE News from L·O·F GLASS FIBERS COMPANY

# BLUE FLAG PROTECTS TIDELANDS WATERLINE!

The ground was so wet that water had to be pumped constantly from the ditch by the well point system shown here. ▶

City engineers of Anacortes, Washington, were faced with the problem of laying over 24,000 feet of large-diameter pipeline — most of it through wet and muddy tidelands, an extremely corrosive environment!

To assure complete protection, Engineers Carey and Kramer specified L·O·F Glass Fibers' Blue Flag reinforcing inner wrap for the pipe, which was wrapped by American Pipe and Construction Co., Portland, Oregon.

Blue Flag pipe wrap is made of special inert glass, which resists the action of soil chemicals. The strong, uniformly porous mat acts to give you pipe with:

- increased enamel strength
- high resistance to cracking and backfill damage
- improved enamel distribution with far fewer "holidays"
- years more service life

. . . all this for less than ½% of your original pipeline investment. Be sure to specify Blue Flag for your over-the-ditch or yard-wrapped pipe. It's available from strategically located distributor warehouses. For full details, write: L·O·F Glass Fibers Company, Dept. 72-17, 1810 Madison Avenue, Toledo 1, Ohio.

L·O·F GLASS FIBERS
BLUE FLAG PIPE WRAP

## L·O·F GLASS FIBERS COMPANY

### TOLEDO 1, OHIO

Makers of glass fibers by the "Electronic-Extrusion" process

**A Complete Line for Pipeline Protection: BLUE FLAG** Reinforcing Pipe Wrap • **DURAMAT** Protective Outer Wrap • **DURAMESH** Pipeline Fabric • **DURATAPE** Pipeline Joint Wrap

# Contractors Association Has Met Challenge Of a Booming Industry

## President Clark Bledsoe Reviews Progress

C. C. Bledsoe

*Almost 100 years ago, at Titusville, Pennsylvania, a man named Edwin L. Drake drilled a hole in the ground. He believed he could find sufficient oil to light the lamps of America. His dream came true.*

*The discovery of oil brought problems that had not previously been thought about. The biggest problem was transportation of petroleum products, and during the years immediately following that first well, producing fields were in remote spots, and horsedrawn wagons hauled petroleum in barrels to refineries, if they were nearby, or to railroads or waterways, if a longer journey was necessary. The first commercial oil pipe line was built in 1865. It was five miles long, made of iron pipe two inches in diameter, and it moved 800 bbl of crude oil per day.*

*The growth of pipe line construction in this country and in other parts of the world has been phenomenal. Pipeliners have kept pace with the discovery and use of petroleum and petroleum products. Now an even greater challenge is being met by pipeliners in the construction of pipe lines to transport solids. The recent completion of the coal pipe line in Ohio, and the present construction of the gilsonite line in the western United States are two examples of the engineering and construction advances that have been made in recent years.*

*Because of the size to which the pipe line construction industry has grown, those who have made a career of this calling organized the Pipe Line Contractors Association almost 10 years ago. The contractors felt there were many problems confronting them as an industry that they could more successfully approach as a group. One of the obvious problems has been labor relations, because of the increased volume of construction through heavily organized union areas. Another problem that the contractors decided should be worked upon as a group pertains to safe practices in the operation of equipment and work on the right-of-way, in order to cut down on the number of injuries suffered by construction personnel.*

*Those familiar with the activities of the Pipe Line Contractors Association over the last nine years of its existence know that it has successfully negotiated national pipe line labor agreements, which have done much to preserve labor peace on pipe line construction work during this past decade when the volume of pipe line construction work has been so great. The Association has published and distributed more than 7000 manuals recommending safe pipe line construction practices, and these have been distributed all over the world and have been accepted by many public utility commissions as a guide for regulatory matters.*

*These are only two of the activities of the Pipe Line Contractors Association, and there are many other instances of our participation with various committee groups of the American Petroleum Institute and the American Gas Association in working out uniform and standardized construction methods for the industry. We believe that much has been accomplished through our association during the last nine years, and because of the continued programs for pipe line expansion, not only in this country but also in Canada, it is our firm hope that we who are members of the Pipe Line Contractors Association can establish a standard that will be recognized by the industry as one which will assure the public of the best, most efficient, and most economical means of transporting many, many products across the country.*

*The Pipe Line Contractors Association will hold its Ninth Annual Convention at Boca Raton, Florida, January 13-16, 1957, and we expect more than 800 people to join with us in hearing representative leaders of the industry, and to make plans for the year 1957.*

Earl Allen

John H. Williams

Kenneth A. Owen

Richard A. Gump

R. A. Conyes

Jack S. Gray

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R. P. Gregory

G. A. Manuel

James P. Neill

H. C. Price

R. D. Sheehan

M. S. Williams

# Contractors Set for Florida Meeting

The ninth annual convention of the Pipe Line Contractors Association will be held for the second year at the Boca Raton Hotel and Club, Boca Raton, Florida, January 14-16. Approximately 800 are expected to attend. The program includes outstanding industry speakers and panel discussions led by men of equal prominence. Entertainment will follow the usual excellent pattern. The complete program follows:

**Saturday, January 12**

**All Day** — Golf Tournament begins. Courtesy Polyken Sales Division, The Kendall Company, Chicago, Illinois.

**6:00 p.m.** — Pre-convention cocktail party for officers and directors.

**Sunday, January 13**

**All Day** — Golf Tournament continues.

**6:00 p.m.** — Buffet dinner and dance, Cloister Lounge and Patio Royale — courtesy H & L Tooth Company, Montebello, California.

**Monday, January 14**

**9:30 a.m.** — General business session — Auditorium (open to all).

1. C. C. Bledsoe, President, presiding.
2. Panel discussion of safety matters — Roger Pentzien, Pentzien, Inc.; Carl C. Lavery, Houston Contracting Company; Bennie G. Pierce, H. C. Price Co.; Walter Weir, J. O. Willett.
3. Address by William R. Connole, Federal Power Commission, Washington, D. C.
4. Panel discussion of water and slurry pipe lines — Fred Culpepper, Ford, Bacon & Davis; Colonel F. J. Wilson, Arkansas Basin Authority; David R. Williams, Jr., Williams Brothers Company; W. A. Swinerton, Engineers Limited Pipeline Company; John Henderson, American Gilsonite Company.
5. Presentation of safety awards.

**11:30 a.m.** — Luncheon for all ladies attending the convention — Marlin Beach Hotel, Fort Lauderdale, Florida, courtesy Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.

**12:00 Noon** — Cocktails in Cloister Loggia and luncheon in Patio Royale for all men — courtesy M. J. Crose Manufacturing Company, Inc., of Tulsa, Houston, Denver, Newark, and Edmonton.

**2:00 p.m.** — Golf Tournament continues.

**6:00 p.m.** — Cocktails and steak roast, Cabana Club — courtesy Caterpillar Tractor Company, Peoria, Illinois.

**Tuesday, January 15**

**9:30 a.m.** — General Business Session — Auditorium.

1. C. C. Bledsoe, President, presiding.
2. Report of Executive Secretary Richard A. Gump.
3. Address by Charles S. Coates, Trans-Canada Pipe Lines, Ltd., Toronto, Ontario.
4. Address by Wm. J. Murray, Jr., chairman, Texas Railroad Commission, Austin, Texas.

**11:00 a.m.** — Closed business session for regular members only — Auditorium.

1. C. C. Bledsoe, President, presiding.
2. Reports of committees.
3. Election of officers and directors.

**12:00 Noon** — Luncheon and style show by Saks Fifth Avenue in Patio Royale — courtesy Crutcher-Rolfs-Cummings, Inc., Houston, Texas.

**6:00 p.m.** — Cocktails in Cloister Loggia — courtesy International Harvester Company, Chicago, Illinois.

**7:30 p.m.** — Annual banquet and floor show, Patio Royale.

**Wednesday, January 16**

**8:00 a.m.** — Breakfast meeting of Board of Directors, Polo Room.

**10:00 a.m.** — Meeting of regular members only, for discussion of labor matters — Auditorium.

**Note:** Coffee and cakes will be served in the lobby and in the auditorium in the morning and again in the afternoon each day of the convention — courtesy John Wakefield & Associates, Tulsa, Oklahoma.

## Unsettled world conditions and availability of pipe the two question marks

# 1957 Pipe Line Outlook: COULD BE INDUSTRY'S GREATEST YEAR

TWO question marks are apparent in viewing the 1957 pipe line picture: (1) Effect of unsettled world conditions, and (2) ability of steel mills to fill orders for line pipe.

Otherwise the outlook is glowing.

Actually, 1957 could be the pipe line industry's greatest year. A looked for 4 to 5 per cent increase in domestic oil demand means increased pipe line facilities will be needed—new gathering and trunk lines, stepped up system capacities where possible by addition of pumping equipment, and extension of lines to new producing areas and to refineries not now served. Also, there is a trend to replacement of smaller diameter multiple lines with large-diameter lines.

If conditions develop normally, construction of product pipe lines likely will be greater than crude oil lines, due in part to an increase in the number of pipe lines carrying LP-Gas.

Greatest expansion, however, will be in gas pipe line construction, as it has been for many years. Almost without exception gas distribution companies will show an increase in the number of new customers and this means the need for greater transmission line capacity. Most transmission companies expect a banner year in 1957, and some report the largest budget in their history.

In its annual construction report (October, 1956) *The Pipeline Engineer* stated that 23,461 miles of pipe lines were planned or proposed. This figure was qualified by the further statement that some of this mileage likely would not be built for several reasons—inability to obtain pipe, Federal Power Commission turndown, etc. Generally, this estimate still seems reasonable.

Technologically, the industry apparently is just attaining its stride. The trend definitely is to greater automation. More remotely controlled stations, advancements in the use of meters, automatic samplers and gaging equipment, added emphasis on automatic lease custody transfer, are some of the areas in which automation is expected to expand rapidly.

*The Pipeline Engineer* asked leaders among pipe line operating companies to express an opinion on the year's outlook for the industry. Most of the above statements are based on their observations. Detailed statements follow:

**J. L. Burke**
*President*
*Service Pipe Line Company*

The consequences of the current unsettled world situation could greatly influence the outlook for the pipe line industry in 1957. Without considering the effects of the unpredictable international affairs, all indications are that 1957 will be the pipe line industry's greatest year. Over 9,500,000 bbl of crude per day will be needed to satisfy domestic requirements. This is an increase of 4 to 5 per cent over the crude oil demand in 1956. As most of this increase is expected to move to refineries by pipe lines, the capacity of the nation's pipe line network will have to be increased proportionally to handle the additional crude oil and products movements.

For the industry in 1957, gathering pipe line mileage probably will increase at about the same rate as the crude oil demand increases. The mileage of trunk crude oil lines is not expected to increase as fast, because of the continued trend of laying large-diameter pipe with its greater capacity per unit of length, and because of installations of remotely operated automatic pump stations to obtain smaller capacity increases. This may be offset somewhat by the extension of crude lines to remote producing areas or to refineries not now served by pipe lines, and by the replacement of high-cost, multiple-line, small-diameter pipe line systems with modern large-diameter lines. Unless the steel situation improves radically, however, the large-diameter line construction in 1957 will be generally limited to projects already planned at this time.

The advent of reliable and versatile control equipment has allowed intermediate or relay stations to be operated automatically from local line conditions or remotely from key points on the system. Microwave with its dependability, numerous channels, and adaptability to telemetering functions has given added emphasis to use of remotely operated stations. The installation of new and improved equipment for the handling of more and more pipe line operations by automatic or remote controls will be a definite trend in 1957.

In other phases of pipelining, the automatic lease custody transfer system has proven successful in a number of trial installations and will receive added emphasis in 1957 for the automatic tendering of oil from the producing field to the receiving pipe line. For design and statistical practices, the electric computer will be used more next year as it offers a simplified technique for the correlation of voluminous data quickly at a fraction of the time and cost of manual solution.

For Service Pipe Line Company, the 1957 outlook is the most favorable in its history. While deliveries in 1956 reached an all-time high of nearly 200,000,000 bbl, the deliveries in 1957 are expected to approach 260,000,000 bbl. A good portion of this increase is due to expansion of the system by acquisition or merger of pipe line facilities from other Standard Oil Company (Indiana) subsidiaries. Major expansion and modernization projects completed in the last few years will enable Service Pipe Line Company to handle new and increased deliveries with minimum construction in 1957.

Plans for improvements and additions to our pipe line system are now being completed based on revised delivery forecasts. Indications are that no major large-diameter lines will be laid during 1957, but present plans do include construction of 200 to 300 miles of 6 to 12-in. lines throughout the system. Expansion of the system is contemplated on the main trunk system between Freeman, Missouri, and the Chicago area by construction of three

new remotely operated intermediate stations and addition of machinery at present stations.

Additional increases will be needed on small segments of the system. These increases will be provided by installation of automatic or remotely operated intermediate stations. Other major work contemplated involves modernization of older stations.

In looking ahead to 1957 and the next 10 years in pipe line transportation, I can assure you that by continued attention to new ideas, pipe lines will continue to contribute to the overall efficiency of the petroleum industry in providing the public with improved and low-cost fuels, lubricants, and other products.

**N. R. Sutherland**
*President and General Manager*
*Pacific Gas and Electric Company*

The outlook for 1957 in Pacific Gas and Electric Company's pipe line planning follows a familiar pattern. We are continuing to expand our facilities and obtain larger supplies of natural gas just as we have been doing throughout the postwar decade.

California's population increase continues to be remarkable. This, of course, requires long-range planning to keep our natural gas supplies ahead of growing demands which arise not only from increased domestic consumption but from burgeoning industrial and commercial developments as well.

PG&E gas construction capital expenditures for 1956 approximated $37,000,000. This brought the total since 1949, when we began building the Super Inch, to $260,000,000. Since 1950, when the 34-in. Super Inch first imported gas from Texas and New Mexico, we have added 424,000 customers to our gas service, making the total as of December 31, 1956, about 1,457,000. Our present deliveries over the 502-mile line are 700,000,000 cu ft daily, constituting about two-thirds of our total requirements.

An 85-mile Super Inch looping project will be finished early in 1957, and another 138-mile looping project early in 1958. These projects, which will complete the looping of the entire line, will include some increases in compressor station capacities. After the paralleling is completed, the line will have a daily transmission capacity of 1,025,000,000 cu ft.

Also scheduled for completion in 1957 is an 83-mile main down the Sacramento Valley's west side from Beehive Bend and three adjacent fields to Sacramento, with pipe line diameters of 16, 18, and 20 in. Further, we plan to build a major portion of a 200-mile, 12-in. line from the Beehive Bend area northwest over rugged mountains to Eureka and the Humboldt Bay area. This line is scheduled for completion early in 1958.

**W. C. Kinsolving**
*President*
*Sun Pipe Line Company*

Until very recently, the outlook for the petroleum pipe line industry for 1957 appeared to be a normal one, taking into account about a 4 per cent normal increase in overall petroleum demand. I think it is felt that the pattern of the past several years would have continued, that is, with relatively larger growth in the products pipe line field than in the crude oil division. There will also be an increased number of pipe lines to carry liquefied petroleum gases. Most of these will be older crude lines converted to LPG service, requiring a considerable amount of reconditioning work. Just recently another one of these projects was announced in Texas by the Gulf Refining Company and it is felt that more such lines will be converted. Possibly some new ones will be constructed in the Middle West and in the East.

However, with the present crisis in the Middle East, brought on by the blocking of the Suez Canal, it is hard to say what changes will be made in our overall oil transportation picture. If the crisis continues and becomes more acute, these changes can be quite drastic. Perhaps it will be necessary for the government to recall one of the "Inch" lines and place it in crude service. It may be necessary to build new lines to the East Coast or make many rearrangements on old lines. Something on the order of the vast shake-up that occurred in the early days of World War II might conceivably take place.

In other words, I do not believe it is possible now to predict or visualize what might have to be done to our pipe line transportation system if the present crisis continues and grows worse. Certainly our transportation program must be geared to the necessity for keeping our crude oil and products flowing to the best advantage, not only for the U. S. economy but for the free world at large.

There is one other disturbing factor which can materially influence the construction program for 1957 and for several years to come, and that is the continuing shortage of steel pipe. The mills are now stating that their order books are full until 1960-61. If this is true, it means that projects now in the drawing board stage cannot possibly be started for three or four years. With the oil business and world affairs moving as fast as they are today, it is extremely hard to have to plan major pipe line projects four years in advance, but such is the case unless these pipe shortages are eliminated or unless they are proven somewhat nebulous. To sum up the above, I would say the situation for 1957 in the pipe line industry is extremely hard to predict.

**Charles R. Younts**
*President*
*Plantation Pipe Line Company*

Plantation has no plans for system expansion in 1957; however, we will be determining maximum utilization of the new 327 miles of 18-in. diameter pipe line that was laid in 1956 parallel to two mainlines.

The new 18-in. pipe line will have an initial capacity of 59,000 bbl per day based on the additional pump capacity placed at the Baton Rouge station only. Thus, the total initial capacity of the company's lines from Baton Rouge to Helena in 1957 will be 304,000 bbl per day.

To handle the additional quantities moved through the new 18-in. line and to give the system more flexibility, five remotely controlled pumping stations have been placed on the system. The three new satellite stations on the mainlines (Winder and Hartwell, Georgia; Simpsonville, South Carolina) were previously manned boosters, whereas the two satellite stations on the 8-in. lateral line northward into Tennessee (Lindale and LaFayette, Georgia) are new installations. Leased wires are used for the transmittal of operational intelligence back to the mother stations at all these points.

An indication of what is in the future can be surmised by reviewing the past. Throughput of the system increased from a postwar low of 59,430 bbl per day average in 1946 to 100,026 bbl per day in 1949. From 1948, until the completion of a parallel mainline in 1951, the system's capacity was being prorated. The expansion in 1951, with an input capacity at Baton Rouge of 245,000 bbl per day, was estimated to be sufficient to handle shippers' requirements into the 1960's. Even the most optimistic predictions fell short of estimating what tremendous growth this Southeast would have, and in 1956 we expanded again.

There are ample areas for additional expansion of the system. Presently, only the initial pumping station at Baton Rouge is on the new 18-in. line, but others will be added and the line will be extended as conditions justify.

**Orville S. Carpenter**
*President*
*Texas Eastern Transmission Corporation*

The outlook for the natural gas industry for 1957 and in succeeding years

is bright and optimistic. We have an ideal fuel to deliver to markets that are constantly increasing. To keep pace with this growth our facilities will have to be continuously expanded. In 1957 we will see many new expansion projects undertaken by the various segments of the industry. New developments in exploration, production, transmission, and distribution will be forthcoming that will better enable us to serve the demands for fuel that is already supplying about 26 per cent of our country's energy needs. We also hope to see solution of many of our major problems during 1957, particularly those of a legislative and regulatory nature.

As for Texas Eastern, the year 1957 will see our system capacity expanded to transport up to 1,630,000,000 cu ft of gas daily. The Federal Power Commission granted authorization for this expansion program on October 9, 1956. The program includes importation of substantial amounts of natural gas from Mexico, and will necessitate construction of additional pipe lines, compression facilities, loop lines, and sales and metering points.

Hearings are expected to be completed in 1957 on a second phase of the company's expansion program that includes reconversion of a large segment of the Little Big Inch pipe line to the transport of petroleum products. Upon receipt of FPC authority for the removal of the Little Big Inch from gas service, construction of necessary facilities and lateral lines to carry out the reconversion will begin. The products system is expected to begin operations during 1957.

**D. M. Morrison**
*President*
*Trans Mountain Oil Pipe Line Company.*

Since 1950 British Columbia and the U. S. Pacific Northwest have become very pipe line conscious. With one major oil pipe line now operating and its counterpart in Canada for natural gas more than half completed, the pipe line industry has naturally stirred up a great deal of public interest, both locally and nationally.

Consequent on the rapid development of the Alberta oil fields and the construction of the Trans Mountain Oil pipe line from Edmonton, Alberta, to Vancouver, British Columbia, and Ferndale/Anacortes, Washington, there has been an expansion in the Canadian refining industry in British Columbia and the state of Washington is rapidly developing into a significant petroleum refining area. This together with the availability of natural gas should stimulate industry in general in these regions and in particular one would look for the establishment of petrochemical manufacture as a natural development along with the refining industry.

Certainly the conditions now prevailing in the Middle East will tend to expedite the movement of Canadian oil to the West Coast, both for refining in the area and for export to California and possibly other countries such as Japan. It seems unlikely that the opposition to crude oil imports into the United States will greatly interfere with this business. Economics will no doubt prevail. To this end the directors of Trans Mountain have initiated engineering studies looking to the expansion of the system from 200,000 to 300,000 bbl per day with provision for increases beyond that as markets develop.

In summary, the buoyant economy that existed during 1956 is expected to carry on through 1957.

**N. E. Tanner**
*President*
*Trans-Canada Pipe Lines, Ltd.*

Trans-Canada has completed the laying of approximately 200 miles of 34-in. pipe on its western section, which runs from the Alberta-Saskatchewan border east to Winnipeg. The laying of pipe will continue as long as the weather permits. Other sections of the line have been surveyed and cleared so that construction can go forward early in the spring. The pipe will continue to arrive during the winter and will be stored along the route. The Assiniboine River crossing in Manitoba was completed in the fall of 1956.

The program for 1957 is to complete the 34-in. line to Winnipeg and the 30-in. line from Winnipeg to Port Arthur and Fort William.

Also, if a permit is granted by the Federal Power Commission, which will make gas available at Niagara to serve the area from Toronto to Montreal in time to make it possible, the line will be constructed from Toronto to Montreal. In any event final surveys and certain clearing of property will be proceeded with along the portion of the route lying east of Port Arthur and Fort William, so that the project may be completed in 1958. All necessary pipe for the completion of the whole line has been purchased.

Midwestern Gas is continuing with its application before the Federal Power Commission for a permit to import gas at Emerson. When this is granted construction of the Winnipeg-Emerson lateral will go forward.

The Alberta Gas Trunk Line project will be built in sections as required to meet the needs of Trans-Canada.

Naturally the making of a market available for the natural gas will stimulate a much accelerated drilling program and the building of the necessary plants in the fields to make the gas available to supply the market. Also, much work will be undertaken by the distributing companies and industries in order to be ready to receive the gas when it arrives.

**G. W. Wadsworth, Jr.**
*President and General Manager*
*Southern Counties Gas Company of California*

At this stage (somewhat preliminary), Southern Counties Gas Company of California in 1957 expects to have a budget of approximately $27,000,000, and add around 55,000 customers to its lines during the year. The budget total is the highest in the company's 45-year history, substantially exceeding our 1956 budget of $19,645,000. Number of customer additions is second highest in our history, topped only by the 68,000 new meters added during 1956.

Pipe line additions planned include 12,000,000 ft of various sizes to our distribution system — with only about 400,000 ft of this scheduled for replacement work. As you may know, this company, along with its affiliate, Southern California Gas Company, is building a 241-mile, 30-in. pipe line from Needles, on the California-Arizona border, to Newhall, just outside of Los Angeles. Cost of this project is to be $24,800,000 and includes a compressor station at Needles, which will house three 2000-hp units. Southern Counties' share of this outlay will be approximately $7,400,000, which total is included in the $27,000,000 budget for 1957.

**Hill Sanders**
*President*
*Mid-Valley Pipeline Company*

It is rather difficult at this time to try and predict the outlook for the pipe line industry during 1957 with the Middle East situation as it is. However, I do believe that we will see additional big inch crude lines constructed and many products lines added to those that are now in existence if the materials are available for their construction. I also look for much more advancement from a technological standpoint by the use of meters, automatic samplers, and remotely controlled stations.

As far as Mid-Valley is concerned, I do not see much of a change from our operations during 1956 as our line has been running at a very good rate and we do not anticipate any additional capacity at this time.

**Grove Lawrence**
*Vice President*
*Southern California Gas Company*

Our company and Southern Counties Gas Company jointly will complete, in 1957, the Alhambra-Needles 30-in. pipe line project to bring additional out-of-state gas to Southern California. Construction on this project was started in 1956 with the installation of about 40 miles of 30-in. line from Alhambra to Newhall. About 240 miles of 30-in. line from Newhall to Needles, and a 1400-hp compressor station near Needles will be installed in 1957.

**F. E. Kalbaugh**
*General Manager*
*Southern Pacific Pipe Lines, Inc.*

In my opinion, the coming year holds much for the industry. The phenominal growth of the pipe line industry, particularly since the close of World War II, is indicative of the common acceptance of this most efficient, economical, and advanced method of transportation.

The progress that has been achieved in pipe line design, construction, and operation in the last few years gives every indication that this progress will continue in the future, and with the industry being ever alert to new and better ways of performing its responsibilities, there should be no reason why the forward progress through 1957 and subsequent years should not continue.

**Ralph F. Moore**
*President*
*Platte Pipe Line Company*

Platte Pipe Line Company does not have any expansion plans for 1957.

As you probably know, our line is of sufficient size to take care of anticipated volumes. Infrequently we are required to add additional horsepower in order to handle volumes received. Last fall we added 1300 hp at our Lost Cabin station and replaced the reciprocating pumps with centrifugal pumps. This work was completed by January 1.

**R. K. Paine**
*Manager*
*Pipe Line Department*
*Standard Oil Company of California*

The coming year, no doubt, will be one of further great strides in pipelining. The various announced natural gas, crude oil, and products lines are true indications of progress.

We can expect the development of automation within the industry to continue at a rapid pace. The trends started in the last few years will become even more popular in the years to come. The numbers of automatic pumping stations, automatic gaging and metering units, and automatic lease purchase installations will continue to multiply and improve the industry operation.

**J. L. Irvin**
*General Manager*
*Pipe Line Department*
*Gulf Refining Company*

Considering the present confused international situation, I think it would take a pretty brave man to predict what the pipe line industry may be called upon to do during 1957.

Unquestionably, the development of technological improvements in pipe line construction, maintenance, and control will be emphasized not only in this country but in other parts of the world where pipe lines play a vital part in the transmission of crude and its derivatives. But there again, much depends upon whether the situation develops normally or whether lines must be built to meet emergencies.

As far as we of Gulf are concerned, we have no plans in the way of additions to our system that we are ready to announce at this time.

**S. D. Whiteman**
*President*
*Kansas-Nebraska Natural Gas Company, Inc.*

I think we can look for renewed efforts on behalf of all segments of the industry to free the producer from federal regulation. Also, pipe line companies should be provided the incentive to engage more fully in production and exploration activities in order to further insure the customer of greater supplies of natural gas at reasonable rates.

Undoubtedly the entire industry will further avail itself during 1957 of new technological advances in the interest of more efficient and dependable operation. Again, this will benefit the ultimate user of natural gas through continued good service at low rates.

At this date it is difficult to predict what changes will take place specifically at Kansas-Nebraska, and I would not want to venture a statement in that regard at this time.

**C. I. Wall**
*President*
*Pioneer Natural Gas Company*

Present indications are that the area served by Pioneer Natural Gas Company (West Texas and Panhandle area) will continue to grow in about the same proportion during 1957 that it has during the past few years. This growth has been at the rate of about 8 per cent per year.

Our present construction budget for 1957 covers the laying of approximately 67 miles of mainline, varying in size between 8 in. and 10 in. One additional compressor unit of 550 bhp also will be installed.

The above covers work only on our main transmission line and does not cover distribution plant extensions and improvements.

**D. A. Hulcy**
*President and Chairman of the Board*
*Lone Star Gas Company*

We anticipate that the residential, commercial, and industrial development throughout the area served by Lone Star in Texas and Oklahoma will continue at or near the 1956 level. In 1956, our company added 32,300 customers to its system and we expect to add 32,400 in 1957. This will give us a total customer count at the end of 1957 of 820,935, almost double the number of customers served at the end of 1947.

At the national level it is expected that there will be an increase of 10,000,000 natural gas customers in the next decade. By 1965, according to estimates of industry statisticians and analysts, the industry will be serving an average of 38,250,000 customers, an increase of 34 per cent from the 28,479,000 using gas in 1955.

Lone Star Gas Company's transmission and distribution pipe line capacity will be increased to meet the requirements of anticipated system growth and we will add considerable capacity in new gathering lines to connect new fields and additional wells in fields already in process of development. We also plan to increase compressor horsepower capacity where needed and will add a number of dehydration plants at strategic points over our system.

Additional radio and telemetering equipment will be added to the company's already extensive communications system to provide more efficient communications and to improve pressure controls and records.

Lone Star's underground storage capacity was increased some 35 billion cu ft in 1956, giving the company 51 billion cu ft of natural gas storage capacity.

The company will expand and modernize its natural gasoline plant facilities to increase butane and propane production to meet the demands of a swiftly-growing liquefied petroleum gas market.

It is expected that the efficiency of pipe line systems, from the standpoint of initial construction and operating economy, will be greatly increased through an increasing use of electronic computers in connection with pipe line system design. Pipe line construction and operating costs may also be

reduced through the use of automatic welding equipment and more efficient coatings, possibly plastic instead of asphaltic; it has been found that plastic coatings have higher resistance values and that more miles of pipe line can be protected cathodically if plastic-coated. We also expect to see an increasing use of plastic pipe in low pressure distribution and gathering systems construction.

**Stuart F. Silloway**
*President*
*Pacific Northwest Pipeline Corporation*

This year should be a good year, one in which a continuation of the rapid expansion of production and transmission facilities will take place in order to keep pace with the still growing markets. Natural gas sales may even accelerate more sharply should our country find it necessary to increase exportation of oil because of the Suez situation but, of course, no one desires gain in competitive position based on such a circumstance. Our industry's expected additional growth to continue the pattern of the last 20 years will not, however, be without problems.

It appears reasonable to anticipate that 1957 will afford no easement of the difficulty in arranging financing. Interest rates will remain high although our industry will be able to obtain necessary additional capital for all sound projects. I do not feel that tight money and higher rates will deter expansion plans to serve the increasing markets.

It is possible that in 1957 there will be some shift from bonds to long-term bank loans and more common stock issues in new financing. For the longer pull, higher interest rates might even possibly result in a re-evaluation by the Federal Power Commission of the present 6 per cent to 6½ per cent allowed earnings for transmission companies.

Also a possibility in 1957 are substantially higher freight rates and an increase in the price of steel. Although pipe mills are already booked with orders through 1958, Pacific Northwest fortunately has been able to provide for its total 1957 pipe requirements for the construction we contemplate.

Technologically, we will see in 1957 greater use of longer joints of pipe resulting in faster and more economical construction. Very possibly a higher percentage of the larger pipe sizes will be used. Also, 1957 will bring an acceleration of the trend toward the use of plastic and synthetic pipe coatings, perhaps applied in the mill.

In drilling activities, the recently developed process of formation fracing will be further refined. The efficiency gained will have a very important effect on the development of additional gas reserves. Formation fracing and continuing improvements in tools and equipment will do much to hold drilling costs down. The entire industry will be watching the performance of the foreign-designed turbodrill with great interest.

In the fall of 1957, the first major importation of Canadian gas will take place when our pipe line begins to receive over 300,000,000 cu ft per day from Westcoast Transmission Company, Ltd. As the natural gas from the Peace River area of Alberta becomes available, Pacific Northwest will then control substantial reserves at both ends of our line.

Pacific Northwest Pipeline is at present planning a $30,000,000 drilling and construction program, already certificated. Principal items are the proposed drilling of 102 wells, building approximately 1000 miles of additional gathering systems, and 70½ miles of additional sales laterals. Our sales laterals are scheduled as follows: 38½ miles of 8⅝ in. from Spokane, Washington, to Chewelah, Washington; 17 miles of 6⅝ in. from Boundary, Washington, to Metaline Falls; 15 miles of 10¾ in. from Pacific's mainline to Olympia, Washington. We are also planning to construct Compressor Station No. 18 (8000 hp) at Sumas, Washington, and we will add 1980 hp to our Compressor Station No. 23 at Big Piney, Wyoming. Fourteen more meter stations are planned for 1957 construction in Washington, Oregon, and Idaho.

Market-wise in the Northwest states, which received their first natural gas only in the late fall of last year, we expect 1957, and particularly the summer months, to show very heavy gains in conversion and new installations. We are also hopeful of Federal Power Commission approval of still other applications already filed, including plans for Pacific Northwest Pipeline and other transmission companies to serve Peoples Gas, Light and Coke Company of Chicago.

Pacific's subsidiary, Northwest Pipeline Corporation, was recently formed to develop plans in 1957 for the construction and operation of a crude oil and products pipe line from the Four Corners area to Salt Lake City, Utah, refineries.

The pending acquisition of Western States Refining Company properties at Salt Lake City, and Farmington, New Mexico, by another Pacific subsidiary, Northwest Production Corporation, through an exchange of shares, should be an accomplished fact in early 1957.

The 1957 building program of Pacific Northwest Pipeline will not be limited to pipe lines and appurtenances. Early in the year, construction will begin on our proposed $2,500,000 headquarters building in Salt Lake City.

Agreements announced November 8, 1956, by Pacific Northwest and El Paso Natural Gas Company provided for the offer of an exchange of shares by El Paso to the Pacific stockholders but will probably not be finally resolved until well into 1957. While it has already been announced that Pacific Northwest will continue to operate as a separate entity if the exchange of shares is consummated, greater flexibility and efficiency of our two systems should be possible soon thereafter. 1957 may be a year of great progress toward providing California with badly needed additional gas supplies.

You will observe, then, that our young but already extensive system will be among the leaders in maintaining the industry's record of vigorous, forward-looking achievements — always seeking to better conserve and correlate our nation's energy supply and to better serve the consumer.

**B. W. Winters**
*Vice President and General Manager*
*Southeastern Pipe Line Company*

The year 1957 should be a continuation of what the year 1956 has been except that the Suez crisis should cause a greater overall transportation of crude and products. From a technological standpoint the industry has continued a steady progress in increasing the efficiency of its operation. Larger lines have replaced smaller ones. More powerful prime movers are being used. All this means greater production with lesser cost. The savings thus made are necessary to take care of the increased cost of labor, equipment, taxes, etc. It all is part of the great American plan of greater efficiency with lesser cost.

From a construction standpoint, all the available pipe produced will be used. Many projected lines will have to wait their turn until pipe can be made and delivered. The economy of the whole world is improving so greatly that steel is at a premium. There isn't enough pipe to meet the anticipated requirements. The steel strike in 1956 held back millions of tons which could have increased steel inventory especially with the automobile industry having a slow-down between model years.

The foregoing means that the pipe line transportation industry will continue to operate at top capacity and efficiency during 1957.

The Southeastern Pipe Line Company is continually making studies of ways to improve its economic position. At the present time these studies have not been completed sufficiently to indicate whether or not we shall make any changes in our physical plant during the year. ★ ★ ★

**Alaska** . . . frozen tundra and its inherent heaving action, seasonal extremes in hours of daylight, were problems.

**EXCLUSIVE**

***Foreign Contracting***

# Primary Factors That Mean Profits

**Financial success depends largely on precontract investigation of geography, regulations, and local conditions; contract protection for variables; experience**

**John H. Williams**
*President, Williams Brothers Company*
*Tulsa, Oklahoma*

THE success of a contractor in foreign operations is generally dependent upon a few primary factors:

1. His familiarity with the terrain, type of soil, and seasonal climate as it affects the proposed construction schedule.
2. The rate of exchange and the stability of local currency.
3. His knowledge of taxes and duties on materials, equipment, and labor — both expatriate and local.
4. His protection in case of force majeure.
5. Scheduling of materials and equipment with adequate time allowance for transit to prevent construction delays.

Each of these factors and some secondary items, such as housing, labor, procurement, construction costs, are discussed in this article.

Geography of the project area is of prime consideration. The accompanying photographs of four recently

**Colombia** . . . the project from Buenaventura to Cali, where excessive annual rainfall affected cost of construction.

completed projects by Williams Brothers, depict a difference in geographical conditions and resulting problems. These projects were in Alaska, Colombia, Bolivia, and Iran (Persia). They are fine examples of the necessity of ground reconnaissance prior to contractual negotiations with the customers.

Alaska presented the unique problems of extreme cold, frozen tundra soil with its inherent heaving action, and seasonal extremes in the hours of daylight — an important factor in itself to any contractor. It seems worth recalling that variations in daylight hours are proportional to the distance from the equator. Alaska remains light enough during the summer to work two 10-hour shifts, and remains too dark in winter to make outside construction practical.

Colombia is near the equator, where daylight hours are the same each day regardless of season; however, geography greatly affected the construction cost of the project shown, from Buenaventura to Cali. Rainfall in Buenaventura, where a pump station was constructed, averages more than 300 incessant inches per year. Fifty miles inland along this pipe line only about 15 in. of rain falls annually. The pipe line depicted passes through dense jungle for the first part of the traverse, then lays along a mule trail some six feet wide carved from a mountainside by the Spanish Conquistadors. Through this section pipe joints were strung by mules, due to inadequate clearance for vehicles.

The Bolivian project shown presented other unique problems due to geography. The pipe line crests at 14,800 ft through the Andes, with more than 100 continuous miles above 13,000 ft. Construction tractors required supercharging, and the thin air reduced the energy of expatriate employees. (Nationals in the region innately have large lungs.) The route of this project crossed many arroyos, which affected the construction season. These arroyos are dry in some seasons and likely to be raging torrents in others. Bolivia is south of the equator, where seasons are reversed from northern latitudes.

**Bolivia** . . . high altitude through the Andes made supercharging of tractors necessary, thin air reduced energy of expatriate employees.

The Iranian project traversed a desert of intense heat, where shade temperatures of 130F are common. Scarcity of water was a problem.

Such projects as these must be carefully scheduled to avoid all possible seasonal hazards — cold, heat, rain, floods, and limited daylight. Work stoppages are very costly where construction equipment and expatriate employees can not be temporarily shifted to other projects without exorbitant expense.

### Hazard of Inflation

Local inflation may present a hazardous gamble to the contractor. A contractor may predict local labor expenses at a current exchange rate, only to have the rate of foreign to U. S. currency change radically before the project is complete.

In one country, the legal rate is 2.5 units to one U. S. dollar, and for years the free market rate was maintained at about 3.2:1. Suddenly in the past few months the free rate has risen above 5.5:1. The difference between

**Bolivia** . . . unloading equipment. Scheduling materials and equipment shipments required detailed attention.

legal and free rate of exchange can also affect the U. S. contractor, because in a given country some materials costs, duties, and taxes may be based on free rate, some on legal rate, and some concurrently on various combinations of the two.

Freight, insurance, duty, taxes, right-of-way, damages, registry fees — all are variables that must be fully understood by the contractor or absorbed by the customer by contractual agreement. Generally, the duty on imported materials and equipment is much higher on goods already produced within a country, and possibly nil for items not manufactured and needed within a country. Goods generally may be transported duty free through intermediate countries before destination, by "in bond" transit — if shipments are sealed from border to border.

It is difficult for the contractor to assume no risk by force majeure. Delays in material and equipment deliveries, strikes, embargoes, civil disturbances, breakdown of public utilities and transportation systems, fires, floods, landslides, and many other happenings can and do slow down or stop construction activities. It is difficult and often impossible to be fully protected financially against all such force majeure hazards.

### Scheduling and Expediting

Scheduling materials and equipment shipments requires much attention for foreign work. The shipment of certain items usually will control the field construction schedule. Switchgear, pumps, engines, mainline pipe, and tanks are examples of material that generally must be ordered in the initial stages of design. Ocean freight may require months, and it is not uncommon to effect expensive air freight for delayed delivery items. Air freight also may be required for spare parts of construction equipment.

Expediting and keeping track of materials in transit are equally important as proper scheduling. Our company employs a central forwarding agency to prepare all exports. The agency handles the flow of material from requisitions and purchases of our central purchasing-traffic department. All export licenses, permits, and other international liaison work is performed separately in Washington, D. C.

Each piece of materials or equipment is accompanied by a combination commercial-invoice packing-list, that serves as a receiving report from the destination. A weekly summary is issued by the purchasing-traffic department to show the transit details of each shipment. A receiving warehouseman is stationed at the port of discharge, where goods may be transferred from ship to rail. This warehouseman must report any inconsistencies immediately to insure a successful scheduling operation.

**Iran** . . . erecting a camp for spread workmen. A desert location where shade temperatures of 130F were common.

Frequently shipments will be damaged in transit due usually to stevedore-mishandling. For instance, tank sheets were dropped into the sea recently, some 7000 miles from the manufacturer. Small crates are subject to vandalism and theft. The receiving warehouseman's immediate report initiates replacement and prevents construction delays.

Skilled construction positions are almost without exception filled with expatriate employees who have proved their reliability to our company. It must usually be assumed that local foreign labor requires complete training. In many countries the government requires that a minimum number of local employees be hired for every expatriate.

In general, labor procurement presents little problem. The usual long hours and inherent overtime pay of pipe line construction are accentuated on foreign work, to limit the length of the project where overhead is high. Expatriates are attracted by large paychecks due to overtime and social benefits, while local labor is attracted by pay and seemingly by an interest to learn.

Expatriates are generally housed in portable camps, which leapfrog as a pipe line progresses. These camps are composed of tents or trailers, with modern kitchen and bath facilities, usually exported from the U. S. All food for expatriates is exported from the U. S., or of similar quality.

The cost of construction in foreign countries is generally higher than in the U. S., due to the reasons and risks described. A contractor's greatest insurance for reasonable profit in foreign ventures is a precontract investigation of geography, regulations, and local conditions; adequate contract protection for variables, and experience in the region. ★ ★ ★

## Revenues of Oil Pipe Line Companies Show Sharp Rise

Revenues of leading oil pipe line companies showed a sharp rise the first nine months of 1956 compared with the same period in 1955. The 67 large companies subject to jurisdiction of the Interstate Commerce Commission report revenues amounting to $504,112,-168, compared with $455,802,494 for the corresponding period in 1955, an increase of 10.6 per cent.

Increase in the volume of oil percentagewise was even greater — 11.3 per cent. During the first nine months of 1955 the number of barrels of oil originated and received from connections by these carriers totaled 2,914,-798 bbl as compared to 3,243,395 bbl in 1956.

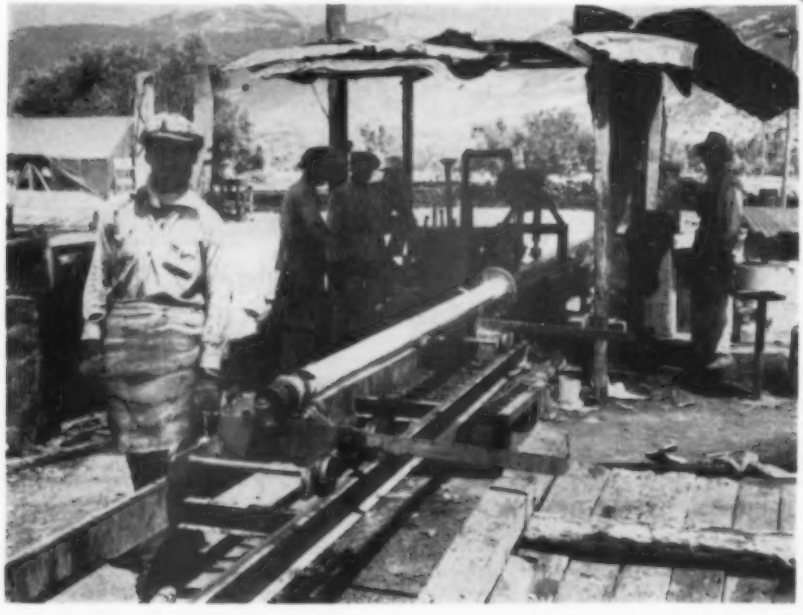
AN American pipe line contractor wanting to do work in a foreign country must be willing to face many unknown obstacles. This, even though he has given considerable time and study to the project and the country with which he plans to do business — and thinks he knows most of the answers.

In our case, we spent approximately three years acquainting ourselves with local conditions in Turkey before we bid on a project in that country. In addition, we formed a partnership with a Turkish contractor. But with all this help and valuable information we had only a faint inkling of the numerous problems that eventually were encountered.

Before we started work our attorney made several trips to Turkey and studied the various phases of accounting and legal procedures that would be necessary. After we had moved our equipment and personnel into the country, however, laws that had been on the statute books for years came to the surface and we were faced with many problems that were not known to the Turkish contractor nor to our own people when we bid the job. This sort of thing, obviously, makes it a matter of trial and error in learning the legal aspects of doing business in a foreign country.

As for working conditions and labor supply, most of Turkey has a great deal of rock, that requires largely jackhammer work, as the local people prefer that method instead of the twin drill operations used in the United States. Obtaining skilled and semi-skilled labor was not difficult. It developed that all laborers were quick to learn one special phase of the work, and after they had mastered that par-

**American welder** with Turkish helper.



**Coating yard** manned by Turkish personnel.

EXCLUSIVE

**Foreign Contracting**

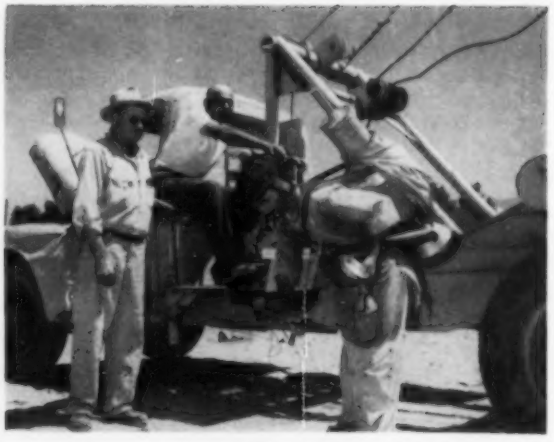
# Overseas Work Has Its Problems

***Despite close study of laws and other factors, the contractor likely will encounter many heretofore unknown obstacles when he gets on the job***

**Earl Allen,** *President*
*Associated Pipe Line Contractors, Inc.*
*Houston, Texas*

**Hauling coated pipe** to be loaded on railroad cars.

**Making a road crossing** — American backhoe, Turkish labor.



**Water boy** making his rounds.

ticular duty became excellent workmen.

In procuring persons interested in working on the pipe line project we dealt with labor unions. The unions are run and controlled by the government. Different divisions are set up and one must report to these division headquarters as the line passes through that territory. It is somewhat similar to union divisions in this country.

### What of Costs?

It is difficult to compare construction costs with those of the United States because there are so many taxes and laws that are unknown to the contractor when he estimates or bids the work.

The cost of moving equipment by boat from the United States to a foreign country, import duties, and, above all, the cost of obtaining parts and supplies, run expenditures on a job out of proportion to the normal cost of doing work in the United States.

As for actual progress made in constructing the line, there is not a great difference; however, operations can be held up by lack of fuel, pipe, and other necessary supplies, which make impossible a fair comparison between doing work in the U. S. and in a foreign country.

For example, on the 425 miles of pipe line that we are building in Turkey, part of the pipe was shipped by rail. Small wagons, as they call them, are available but the engines depend on coal for fuel. Just recently when we were running short of pipe and finally ran out of pipe, we discovered all railroads had stopped operations because a boat load of coal had run aground at the Port of Iskenderun and they were busy trying to get coal to keep the trains running. This delayed us several days, as the crews were out of pipe before they could get the engines back in operation.

The housing situation is not too great a problem. There is only one solution, however, and that is to establish an American construction camp with all the latest facilities for the convenience of American personnel. The housing of local laborers is not difficult because in most cases there are numerous small cities that can take care of them as the project moves across country. It is necessary for the camp to supply its own electricity and in most cases its own water.

### Transporting Equipment

Although the cost of transporting equipment to a foreign job is expensive, there are numerous U. S. companies that will give a guaranteed price for delivering equipment at the desired location. In our personal situation we supervised the loading of the crated equipment onto a ship chartered from one of the steamship lines. The equipment was loaded at Port Houston and shipped to Iskenderun. At that point we provided our own personnel to unload the ship because the "know-how" of unloading construction equipment is a most important factor and it would have cost us several thousand dollars had we waited for the Port people to do the unloading.

As a whole, a contractor interested in doing foreign work should first evaluate the situation here in the United States. In our own particular case, when we first began looking over the various foreign countries for pipe line work, it appeared that construction in the U. S. would be slow in developing for the next few years. As it turned out, however, construction on

the job we bid was delayed. Moreover, there is not too much incentive to work in some foreign countries because of the tax situation.

Furthermore, most of the personnel going to Turkey were only interested from the financial standpoint. This is understandable. A man expecting to spend a year or two away from his family must know he is going to be fully compensated for the hardships and inconveniences he will experience by being away from home for that length of time. In our case, we paid for transporting the men to and from the job if they stayed until the contract was completed. We paid salaries equal to or better than the men would have received in the States, and additional bonuses for the days they were away from home if they completed their contract. All board, room and laundry were provided American personnel.

In the case of Turkey, personal income tax is as high or higher than taxes American people are accustomed to, so we made an agreement with the American personnel that we would pay the difference between what they had to pay in Turkey and what they would have had to pay if they made the same money in the United States. This seems like an easy solution to the situation, but there were many difficulties encountered in the case of employees who had worked in other foreign countries before they reported to work for us in Turkey.

### Personnel Turnover High

The turnover of American personnel in Turkey has been well over 100 per cent. Of the original group of 50 men very few will be on the job at the time of its completion and most of these are office and supervisory personnel. Most of the turnover has occurred among operators and not welders, in contrast to the situation here in the United States.

One of the most discouraging problems faced by a contractor working with a foreign government, or working on a NATO project, is the transferring of funds from the country in which he is working back to the United States. One familiar with the set-up in Turkey knows that the contractor is working directly for the Turkish Government although it is a NATO project.

There is no problem of getting paid in Turkish lira, but there is considerable red tape in getting the lira exchanged to American dollars. The main reason is due to a shortage of American dollars in that country. Although the United States contributes the main portion of dollars for the NATO project, there is no guarantee by the U. S. Government that an American contractor will receive even that part of his contract paid for by the American Government. This creates a hardship on the American contractor.

It is generally known among contractors working in Europe that some foreign countries subsidize their contractors when they bid on construction work outside their own country. This will be a great competitive factor working against the United States contractors in bidding on pipe line projects in Europe and the Middle East. U. S. contractors are faced with paying a high scale for American personnel in contrast with the low scale paid by European contractors, and the latter have a guarantee against loss.

Many have suggested that NATO work should be set up so that all payments on estimates be made to the NATO headquarters in Paris. This would be a great help to American contractors bidding on foreign work. It also would speed up payment to contractors on estimates, which is the life-blood of most contracting companies. ★ ★ ★

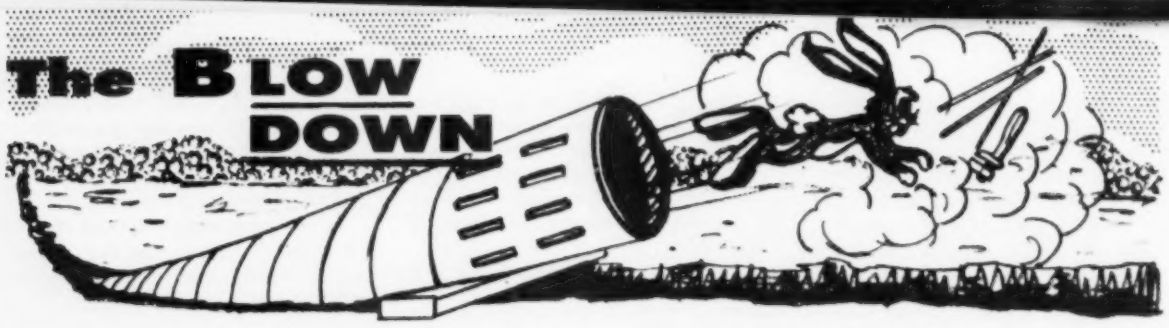
## Valves Still In Use After 28 Years

Valves installed in 1928, when the Arkansas Louisiana Gas Company was laying its 94-mile pipe line between Clarksville and Little Rock, are still in service today. Designed to handle working pressures between 50 to 550 psi, the valves are equipped with water-tight housing for underground installation and are contained in road boxes for easy access during operation and maintenance.

In the photo (top), G. A. Rachel, Arkansas Louisiana foreman, is removing the gear housing cover from one of the mainline valves. Below, the valve, an 800 lb WOG gear-operated Rockwell-Nordstrom is still in service after 18 years, as are the Rockwell-Nordstroms used as blow-down valves and in auxiliary installations — meter runs, scrubbers, and cross-overs.

Arkansas Louisiana's regular maintenance program has helped to keep the original valves in good operating condition. Once or twice a year, valves are lubricated and worked slightly.

Following the installation of the pipe line, the method used to test the line was so unusual a number of people from other companies came to watch the operation. It had been standard practice to blind flange the sections of the line during the test period. Instead, the company closed the valves section by section and built up test pressure to 550 psi in each section. The valve being tested was supported on a skid, the unflanged end pointed into the air at a 45-deg angle. Water was then poured into the downstream throat. Had there been any leakage, it would immediately have become apparent.




***News from the Field and Plant about People you know***

**PIPELINING THE API.** Although the Pipe Line Conference of API in May has shifted emphasis away from the annual meeting in Chicago somewhat, seemingly as many pipeliners as usual were present. Committee work and the fraternal aspects of the gathering likely are the answer. Then, too, the contractors were out in goodly number, and held a meeting of their own to make final plans for the Pipe Line Contractors Association's annual meeting in Boca Raton, Florida, in January. Among contractors spotted in the lobby of the Palmer House were **Hal Price, Clark Bledsoe, Phil Gregory, Fred Parkhill, Dick Gump, Bob Sheehan, Maurice Williams, T. A. Hester, Austin Manuel, Ed Mahoney, W. E. Honey, Oscar Burden, Guy Connors,** the **Williams** brothers, **John, David,** and **Charles, S. D. Bechtel, Jr., S. M. Blair, J. L. Brookbank, Bob Buck, C. M. Collins, Wesley Embry, A. T. Everham, J. W. Hatherly, James D. Hawkins, Marvin Jones, R. G. Murray, M. W. Staples, R. J. O'Connell, Ken Owen, John Robinson, John Wilkinson,** and **Emmett Wilson.**

**Jim Gibbons,** ubiquitous Koppers Company representative, has missed only one API meeting, the one last year in San Francisco. His record: 35 to 1. His reminiscence of the time he fell asleep while dining with **Pat Hurley,** then secretary of war, and in the presence of **Joe Dwyer** and **Bill Love,** is worth hearing. Possibly a unique "distinction."

**Gerry Johnson,** vice president of Sinclair Pipe Line, says construction of the line from Teague to Houston probably will start about March, 1958. During 1956 an 18-in. line was laid from Jacksboro, Texas, to Teague to replace two 8-in. lines, which are now being taken up and some of the pipe shipped to Venezuela for use in a gathering system.

**L. R. "Dick" Dickinson,** president of Trans-Northern Pipe Line, is being kept busy overseeing erection of six new pumping stations on this products system. Four are automatic. Capacity of the system will be increased 35 to 40 per cent by the additions.

Enjoyed the plane ride from Dallas to Chicago as a seat mate to **Charley Breedlove,** Collins Radio Company. Charley recently spent six weeks in Europe. Although his headquarters were The Hague, Holland, he found time to visit England, France, Italy, and Belgium.

**Otto Stallard,** central division superintendent for Magnolia Pipe Line, was beaming over a special citation in appreciation of his many years' work on the API measurement committee.

**Charles Younts,** president of Plantation Pipe Line, says the steel strike set them back about two months on their new construction work, which will now be completed around January 15. Plantation is laying a parallel 18-in. line between Baton Rouge, Louisiana, and Helena, Alabama, and adding to its pumping facilities.

**John de Groot,** president of the Tuscarora Pipe Line Company, is hard at work, as usual, on plans for the API Pipe Line Conference in Cleveland next May. John is chairman of the conference steering committee.

**Frank Hughes,** purchasing agent for Michigan Wisconsin and American Louisiana pipe lines, has been buying pipe line equipment and materials for at least 26 years, so it is understandable why he would know so many pipeliners at the API. We are told he purchased the materials for Northern Natural's original line, and that was somewhere around 1930.

**Austin Manuel,** president of Williams-Austin Company, Pittsburgh, and a past president of the Pipe Line Contractors Association, reported a beautiful summer in his area but too rainy for good pipelining, citing 33 completely rained out days from a total of 90.

One of the first persons encountered upon arriving in Chicago Sunday was **Russ Brannon,** supervising corrosion engineer for Humble Pipe Line Company, hurrying down State Street to a committee meeting. Russ is another who has done his share of serving on API pipe line committees. He also was one of the instructors at the School of Pipe Line Technology, sponsored by the API Committee on Personnel Training, held recently at Lee College, Baytown, Texas.

To set the record straight, **Joe Meehan** is still president of Pure Transportation Company, but has taken on the added duties of crude oil purchasing, which seems to have led to some confusion.

**J. H. Wood, Jr.,** vice president and manager, Atlantic Pipe Line Company, Dallas, was elected president of the Pipeliners Club at the annual meeting at the Palmer House. **Ralph K. Paine,** manager, Pipe Line Department, Standard Oil Company of California, San Francisco, was chosen vice president, and **Oliver C. Klinger, Jr.,** publisher, Pipe Line News, Bayonne, New Jersey, secretary-treasurer.

**O. Q. Lomax,** president, Humble Pipe Line Company, Houston, was named to the board of governors, and **G. H. Supple,** vice president, General Petroleum Corporation, Los Angeles, becomes chairman of the membership committee.

**Court Golden,** vice president of American Oil Pipe Line Company, Houston (merged with Service Pipe Line) made it a fast stopover. Arrived Sunday, left Sunday, on his way to Houston from business in the East.

**Ernie Slade,** president, Okan Pipe Line Company, Tulsa, another hard working committeeman who had been in town since Saturday, bemoaning the loss of revenue resulting from damage by explosion to a gasoline plant at Snyder, Texas, one of their suppliers.

**O. A. Abbey,** general superintendent, products pipe lines, Standard Oil Company of Indiana, missed most of the meeting, being called to Iola, Kansas, due to the death of his sister.

**Millard Neptune,** former president of Platte Pipe Line Company, now manager of Sahara Petroleum Company, Alexandria, Egypt, made plans to return to his home base immediately. Israeli-Egyptian fighting had been in progress five days when he left for the API, and he was anxious to get back and personally look after the interests of his company.

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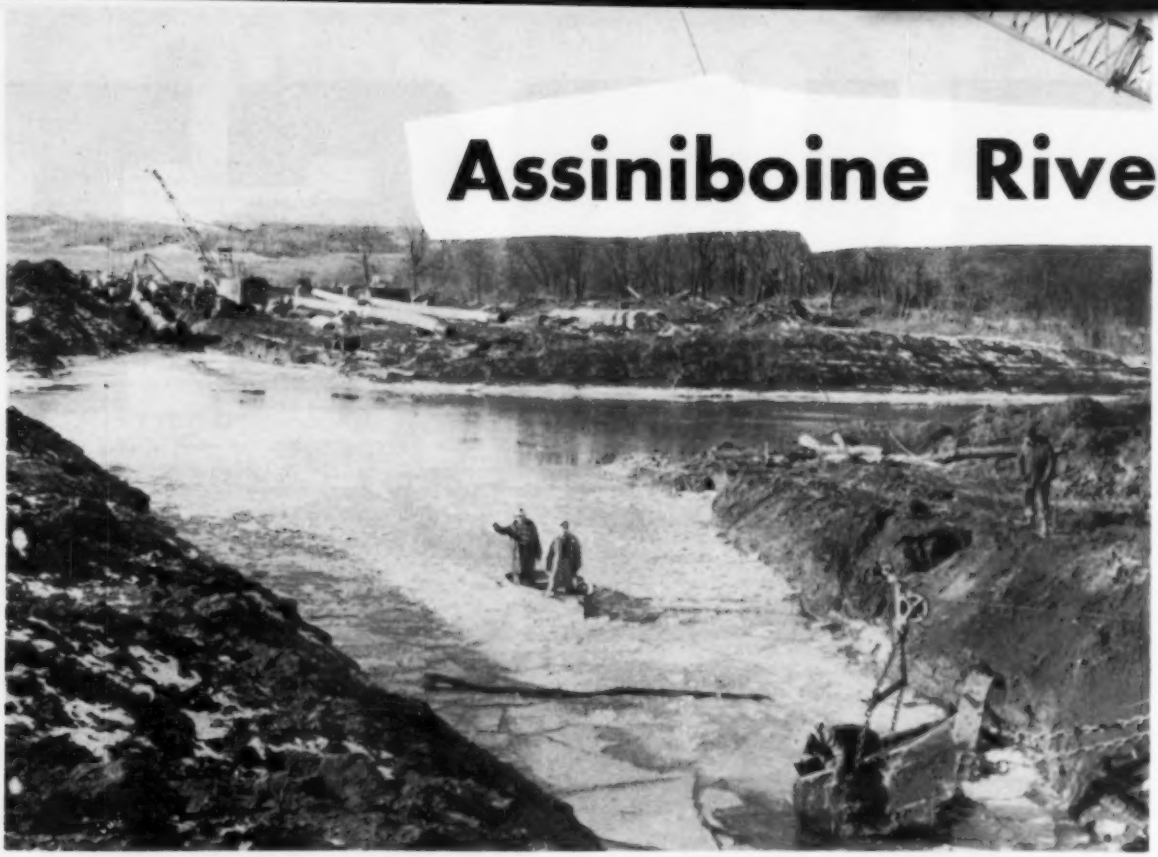
# Assiniboine River



1 Survey engineers had to combat winter ice conditions while taking soundings for the Assiniboine River crossings. The survey crew, taking soundings prior to the first pull, found their boat caught fast in the ice in the below-freezing temperature. Their problem was solved when one of the party boarded the bucket of a dragline, which broke the ice and enabled him to take his soundings.

5 Having the appearance of some legendary sea monster, the section of pipe is being winched across the river. A dragline guided the snout of the pipe into the ditch and two sideboom tractors eased it along the dollies on the marine railway, while a third sideboom acted as a brake at the tail of the section.

P 615.371.

# Crossed in Winter Weather

A 260-ft section of 34-in. pipe was pulled across the Assiniboine River near Miniota, Manitoba, late in November, the first half of two dual crossings of the river to be made by the Trans-Canada Pipe Lines natural gas line from Alberta to Eastern Canada.

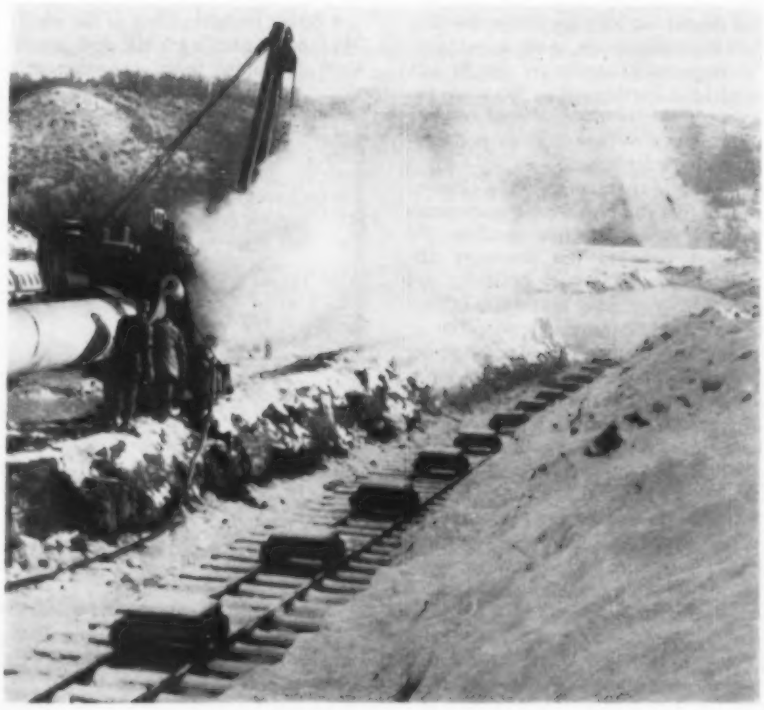
Second crossing of the river at Miniota came shortly thereafter, to be followed by dual crossings of the same river near Portage La Prairie, Manitoba. Contractor for both river crossings is Marine Pipeline and Dredging, Ltd., of Vancouver.

At the Miniota crossing, the general work area was set up on the west side of the river. Here the joints were welded both inside and out, the pipe was cleaned, primed, and given double coats of bitumastic enamel, glass fiber, and kraft paper wrap. The pipe was wrapped in shiplap rock shields, and the whole encased in thirty 6000-lb concrete river weights. Between the weights, wooden slats were wrapped around the pipe for protection. Weight of the pipe as it went into the river was 1100 lb per ft.

The pipe was lowered by three side-boom tractors onto dollies, which ran on rails in the ditch to the water's edge. Air-tight floats were attached to give temporary buoyancy and the pipe then was winched across the 200-ft expanse of water. The ditch ranged from 10 to 15 ft deep in the bed of the river. Including approaches, overall length of the crossing was approximately 1300 ft.

At the Portage La Prairie crossing, the river is considerably wider and the ditch below the river bed is being made by dredging and backhoe operating from the dredge. ★ ★ ★

2 Working area on the west bank where the pipe joints were welded, both inside and out; the pipe cleaned, primed, and given double coatings of bitumastic enamel, glass fiber, and kraft paper; tested, weighted, and the sections placed on dollies on a marine railway in the ditch.



3 Dollies on the marine railway in the ditch leading to the river. Beside the ditch is a 260-ft section of 34-in. pipe receiving a double coating and wrapping treatment. What appears to be a ski slope in the background is the right-of-way on the east side of the river.

4 Ready to roll. First 260-ft section of pipe to cross the Assiniboine River is shown ready to be winched across the river. Exclusive of the floats, the section weighs about 1100 lb per ft after the coating and wrapping, shiplap rock shields, and wooden slats have been added.

# Integration of Mobile VHF With Microwave Radio

## . . . Provides effective communications coverage for large vehicular systems without need for multiple VHF channels

**J. R. Neubauer,** *Manager*
*Systems Communications Engineering*
*Radio Corporation of America*

**EXCLUSIVE**

EXPANSION of communications in the vehicular radio field is faced with a growing problem, mainly because of the serious shortage of available frequencies. This is causing operators to look elsewhere for effective coverage of their facilities and an economical solution to their problem.

Although use of multiple VHF mobile channels is probably the most direct means for meeting comprehensive system requirements, in most instances the required channels are simply not available. Furthermore, most of the compromise solutions offered to date either limit coverage or lower performance characteristics.

Recent experiences have demonstrated that the broad-band microwave channel is an effective medium for bringing together the necessary circuitry to provide system flexibility and coverage by making maximum utilization of a single frequency allocation.

The major growth and development of land-mobile radio has occurred during the last 10 years; however, the use of vehicular communications dates back more than 30 years. The most familiar application has been in public safety organizations, such as the police and fire cars and trucks.

Improvements in design, effecting better and more reliable performance and substantial reductions in cost, have opened many new industrial markets. Organizations whose major activities extend over large areas have found two-way radiotelephone an important tool for expediting better customer service and reducing operational cost.

Petroleum and natural gas pipe lines, and public utilities, have pioneered in many new applications that have provided instant coordination of their complex activities. In recent years, the use of short range, low power equipment has established its usefulness to the petroleum industry.

A better understanding of the methods used in meeting VHF and microwave communications requirements can be had from the following examples of RCA systems now in operation.

### Multiple VHF Channels

Many requirements of a typical system can be met by an all-VHF relay system, if the availability of frequencies is not a governing factor. The typical RCA system shown in Fig. 1 is designed to provide communications for administrative and service personnel between offices and mobile vehicles.

To provide the service required, nine

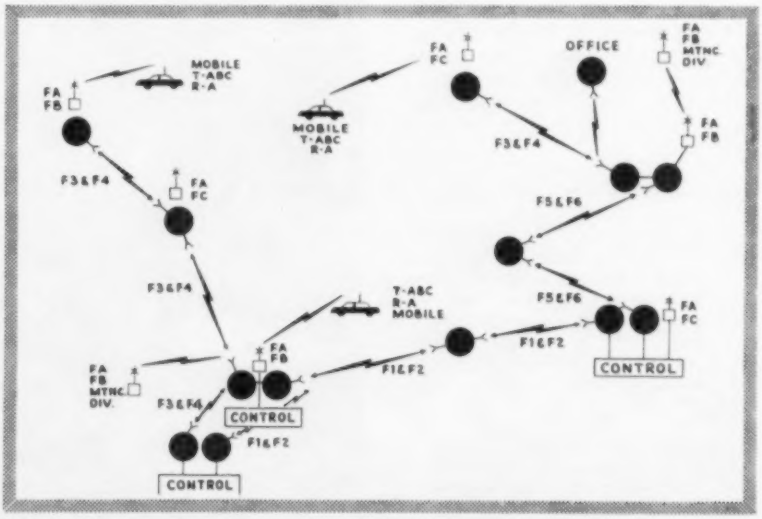



FIG. 1. How complete coverage and administrative control of a large area can be accomplished through use of VHF relay — provided numerous frequencies are available.

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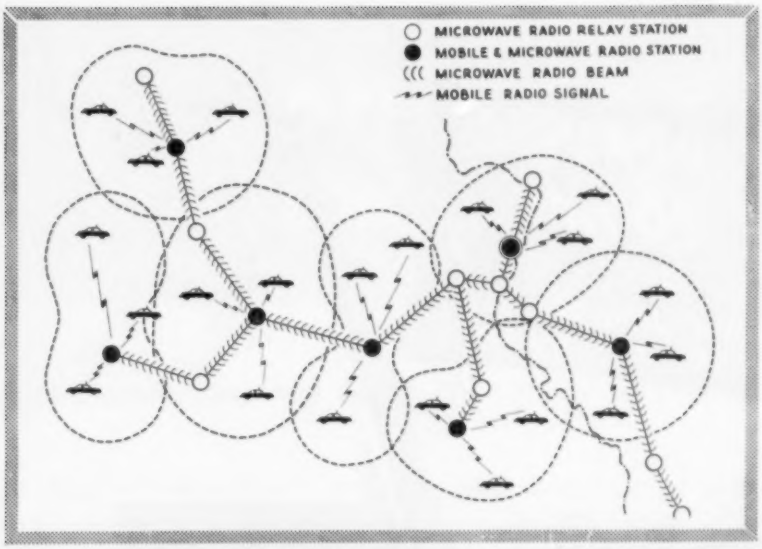



FIG. 2. How a group of VHF stations can be connected and controlled by microwave without requiring the use of numerous VHF frequencies. This is a multiple dispatch system.

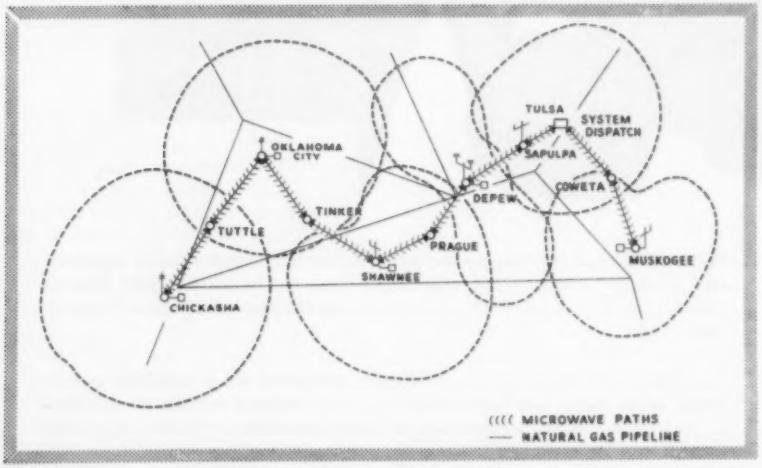



FIG. 3. Network of six VHF stations operated by Oklahoma Natural Gas Company and controlled by microwave. This system employs selective dispatch.

### The Author

J. R. Neubauer, manager, Systems Communications Engineering, Radio Corporation of America, received his educational training at Colorado University and Colorado A&M. After four years as radio technician for the Hendrie and Bolthoff Manufacturing and Supply Company of Denver, Colorado, he joined the engineering staff of KLX Broadcasting Company of Denver. During World War II, he served as civilian instructor in the Signal Corps and later as chief radio operator on a section of the Army Domestic Air Transport Service.

In 1944 he was appointed supervisor of communications for Continental Air Lines of Denver. Leaving this firm in 1945, he organized the Electronic Development Corporation of Denver, a consulting engineering service in electronics and communications, and served as president and general manager. In 1948 he moved to Cheyenne, Wyoming, to become chief radio engineer of the Wyoming Highway Department. Two years later he moved to New Jersey to join the mobile and microwave section of RCA as a design engineer. Early in 1953, Neubauer was made supervisor of the systems communications engineering section, later becoming manager.

He is a senior member of the IRE and its professional group on Vehicular Communications, an associate member of the AIEE, and serves on the RETMA Committee for Systems Standards of Good Engineering Practice.

frequency assignments are used. Three are for base station and mobile use and six provide interconnecting relay links. Mobile service is provided with three transmitting and one receiving channel. This number of channels permits operation in any area between any combination of fixed or mobile stations. The relay station transmitters are controlled by RF carrier sensitive relays in conjunction with interlocking distribution and muting relays.

Each of two control stations provide a different degree of system flexibility. One has a direct wire circuit that takes precedence over the automatic relay interconnect by dispatching simultaneously two repeater legs and a local base station. Automatic interconnect operates either from east to west or vice versa while transmitting locally.

Additional dispatching is effected from nearby offices equipped with fixed station equipment, where operators have directional discretion by selectively activating repeater units or by entering the circuit in both directions simultaneously. Operation is on the frequency of the mobile units.

One control point can be arranged to break into the system and dispatch either selectively or allow automatic interconnection for through service. The system will then remain broken until the operator restores the circuit. Another alternative is to revert automatically to automatic repeat interconnect as soon as local transmitter control is released.

Mobile units may, at the discretion of the dispatcher, communicate directly with another mobile unit in any area along the system, or to any base station. Fixed station receiver frequencies are alternated to avoid adjacent stations capture and feedback loops.

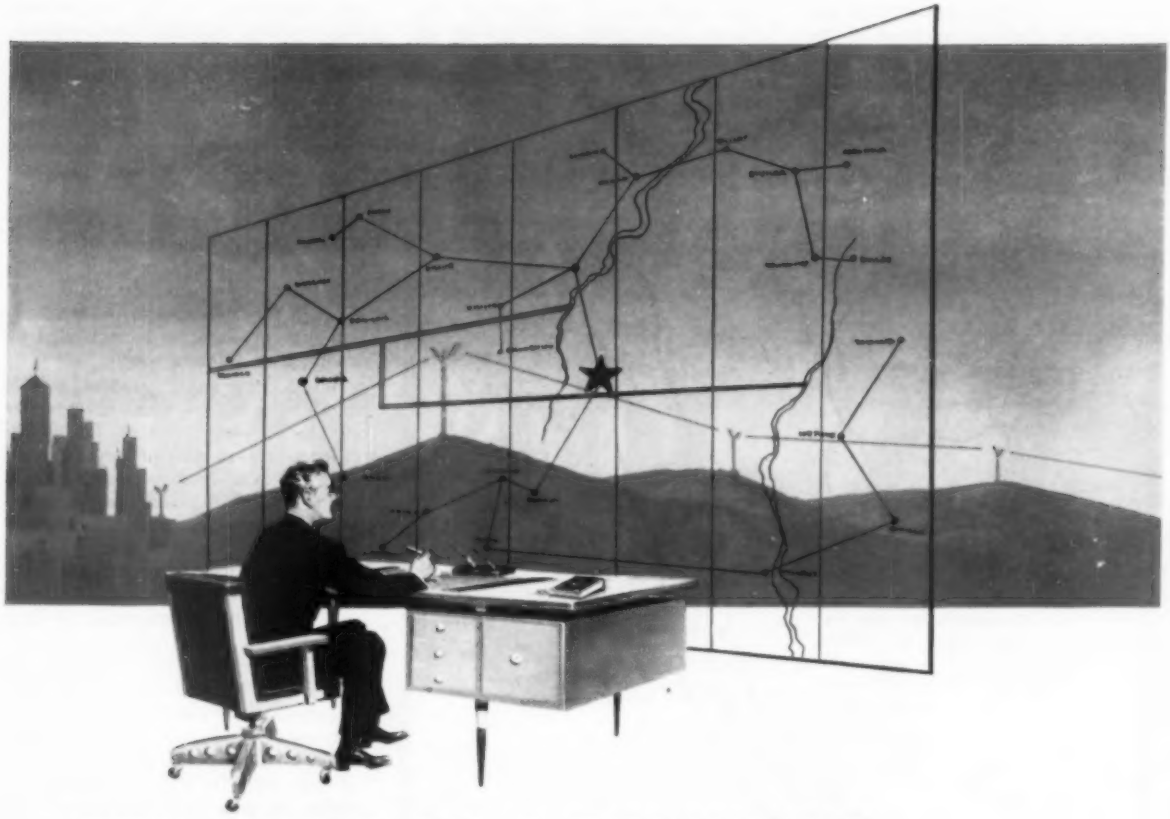
This type of system provides a high order of flexibility, but is limited to not more than two simultaneous message exchanges. It also does not allow independent control by local dispatchers, and is extravagant of frequency spectrum use.

An important disadvantage is that demodulation and remodulation of audio makes noise and distortion difficult to control unless the average deviation in the repeater chain is kept well below the threshold of modulation limiters.

### Multiple Dispatch System

Many of these disadvantages can be offset by multiple dispatch systems that combine VHF radio communications with microwave. As the name implies, this system centrally dispatches via microwave relay, a controlled group of VHF stations distributed so as to cover the area shown in Fig. 2.

VHF propagation is controlled by using directional antennas to prevent



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excessive overlapping of adjacent stations while allowing coverage of the desired areas. This feature gives local dispatchers the option of independent operation without capturing receivers being operated by the system dispatcher.

VHF receivers are provided with an RF carrier operated relay that transmits tone signals on the microwave relay system. These tones remove VHF stations from the system when any one receiver is on the control channel. This prevents speech garbling due to phase delay distortion.

### Selective Dispatch System

The second typical integrated system, diagrammed in Fig. 3, is serving the Oklahoma Natural Gas Company. This arrangement is known as a selective dispatch system. Its main feature is that it selects not only base stations, but also mobile stations. This diagram shows the location of the microwave relay stations and the VHF base stations relative to the pipe line.

The system has six VHF stations interconnected by a series of microwave stations consisting of two terminals, five drop repeaters, and four through repeaters. As in the previous example, propagation is controlled by a choice of antenna arrays.

Interlocking tone control signals multiplexed on the microwave carrier guards the system from any locally dispatched station. Circuits are arranged to bypass the muting control, which can be effected by a weak mobile transmitter signal. By virtue of controlled propagation, the receiver of an adjacent system will favor carriers from mobile units in its own area. This permits simultaneous operation of local control with system control.

The system dispatcher is stationed in Tulsa, and, because there are no VHF transmitting or receiving facilities at this point, a microwave multiplex channel is used to operate the VHF station at Sapulpa, 20 miles southwest, to cover this area. A cardioid directional antenna array concentrates coverage between Tulsa and Pryor to the northeast. Remaining stations at Muskogee, Depew, Shawnee, Oklahoma City, and Chickasha can be controlled either by the Tulsa dispatcher or by a local operator.

Each station is made available to Tulsa control on the multiplex channel by a dial selector. As local districts are given priority, the local control can remove its own station from the system and operate independently. When a local unit is in use the Tulsa dispatcher will receive a busy signal if he attempts to put that station on the system.

Whenever the stations are under system control and a mobile unit calls in, the receiver muting circuits are affected at all other stations through a carrier-operated relay. If a unit call comes in at another point, however, it will be monitored and the local control operator at that point can remove his station and control from the overall system and can then complete the contact independently.

After a station has been selected by the system dispatcher or local operator, mobile units are selectively called by means of a dial-pulsed 2600-cps tone at the dispatch point and a minor switch decoder in the vehicle. A function switch in the mobile unit permits the driver to receive all calls or to use

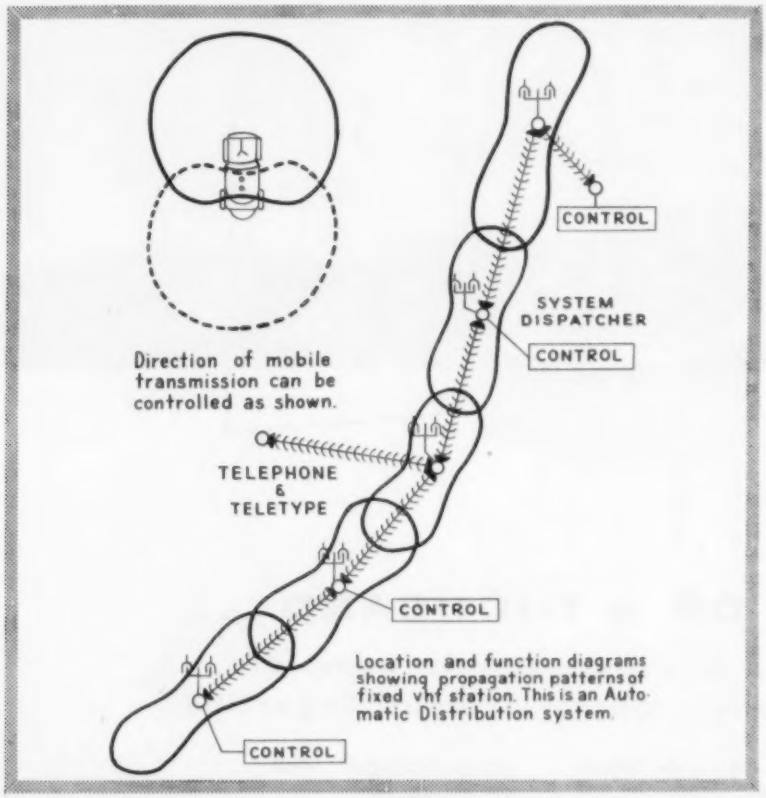
CONTROL
SYSTEM DISPATCHER
CONTROL
Direction of mobile transmission can be controlled as shown.
TELEPHONE & TELETYPE
CONTROL
Location and function diagrams showing propagation patterns of fixed vhf station. This is an Automatic Distribution system.
CONTROL

FIG. 4. Propagation patterns used in automatic distribution system.

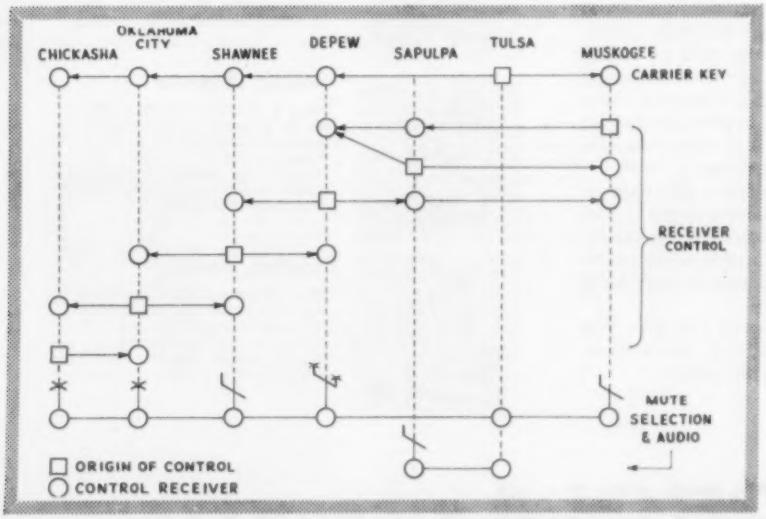


FIG. 5. Chart showing interlocking control signals that are used in a selective dispatch system.

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the "horn alarm" position of the switch to alert him when away from his vehicle.

Each station also can be interconnected with a manual drop on the telephone switchboard in conjunction with a voice-operated relay so that local office telephone calls can be transmitted over the station. Mobile units throughout the system thus can communicate with administrative or supervisory personnel in the Tulsa headquarters or in their local district office.

Teletype and party-line dial telephone circuits are handled by this system also. Eventually, some of the unused channel space will be assigned for telemetering and supervisory control of compressor stations.

### Automatic Distribution System

The third typical system shown in Fig. 4 employs 960-mc multiple channel microwave circuits to establish an automatic distribution system. The bulk of the traffic for this system is distributed by automatic relay controls, which establish information routing without operator participation. At the same time, it is always possible for the system or local dispatcher to assume control, if needed. This illustration is a location and function diagram showing propagation patterns for fixed and mobile units.

As the basic requirement of the automatic dispatch or repeater system is simultaneous operation of transmitter and receiver, antennas are mounted collinearly on a single tower adjacent to the highway. Towers are 150-ft self-supporting structures, with the VHF receiving antennas and microwave parabolas on top, and the VHF transmitting antenna located at the 75-ft level.

Speech garbling in overlapping areas is avoided by the use of controlled bi-directional antennas on the mobile units. A field gain of 5 to 1 is obtained by driving one antenna and using the other as a parasitic director — as selected by the operator — permitting reception by FM discrimination of the strongest carrier. It also effects improved transmission range without unnecessary increase in power.

In this system all receivers and transmitters are interconnected by multiplex voice channels and signalling circuits in order to permit a 10-watt mobile unit to communicate directly with any other unit. Each receiver modulates its own transmitter and all other stations via a derived channel, and is interlocked through sub-carrier keying so that only one unit can modulate the multiplex channel during a given transmission.

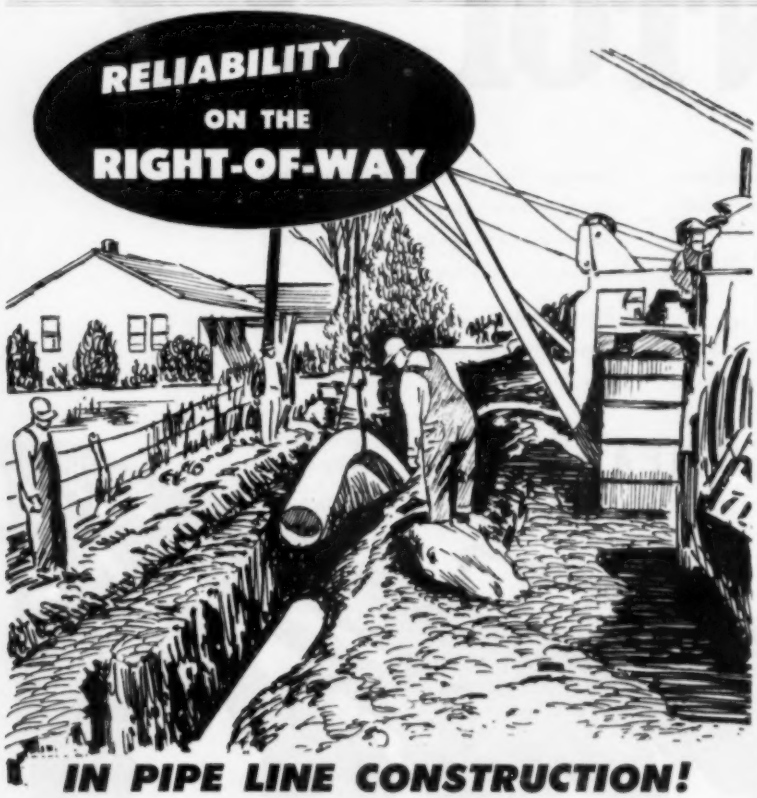
A central dispatcher monitors all transmissions, including those from three district dispatchers. All stations are channeled into central dispatch for automatic station interconnections to fit vehicular load problems. The central dispatcher can assume control of any station throughout the system, taking precedence over local dispatchers and mobile units. Each local operator, however, is limited to the use of his own station.

Local control points are equipped with low-power a-c transceivers using the same frequency as the mobile units. A directional antenna beams their carriers into the system to communicate with their assigned dispatcher.

Other services, such as party-line dial telephones, intercom phones, and teletype also are available at most locations.

### Conclusion

The growth of the petroleum industry has demanded expansion and improvement of vehicular communication services. As these services have spread over larger and larger areas, need for central administrative control has become more apparent. Integration of VHF with microwave offers a practical solution to the vexing problem of channel shortage and has made possible the design of a system that provides flexible simplicity at reasonable cost, by combining effective coverage with moderate power. ★ ★ ★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**Vapor-Phase Cooling**
**Part 4. Conclusion**

# Energy losses reduced, engine output increased by vapor-phase cooling

**Glenn Sanders**
*Engineer, United Gas Pipe Line Company*

AN internal-combustion engine is a machine that converts chemical energy contained in its fuel into heat energy, and further, converts part of this heat energy into mechanical energy at the shaft. (See Fig. 1.) The ideal engine would be one in which all of the input energy is converted into work. This engine would have no exhaust, it would require no cooling, and it would require no power for auxiliary drives. Unfortunately, the construction of such an engine is impossible.

With this as a goal, however, we can strive to build better engines. Manufacturers and users in the past few years have made tremendous improvements in the engines. By turbocharging, by improving combustion efficiency, by improved lubrication, and by other means, the engine output, or work, has been increased at no increase in fuel input. This means that the energy losses have been reduced and the amount of the output increased. One of the methods of reducing these losses by an improved cooling system is the topic of this article.

The internal-combustion engine received its name because its fuel is burned within the cylinder. In modern gas engines, this combustion temperature may be quite high. If we could develop engines that could maintain their strength at these high temperatures, and if we had lubricants that would lubricate satisfactorily under these conditions, we could insulate the engine and reduce the cooling losses to zero. These materials have not been developed, so we must compromise engine efficiency in order that we may use available materials.

In order to keep engine temperatures down to the point that present materials can accommodate, it is necessary to use some cooling medium. This medium may be air or a liquid. When we think of an air-cooled engine, we usually think of power tools or aircraft. These usually have a low ratio of pounds per horsepower and are not built for years of continuous service. In the gas industry, we are primarily concerned with liquid-cooled engines.

## Water as a Coolant

Liquid cooling is used in all large stationary engines of the type used by gas pipe line companies, with water nearly always being the liquid coolant. Some of the reasons for the universal use of water as a coolant are as follows:

**Availability.** It is one of the more abundant materials on earth. Just any water does not make a good coolant for internal-combustion engines, however. It must be non-corrosive and should not leave scale or other deposits in the cooling system.

**Cost.** In most locations, good cooling water can be obtained at a reasonable cost.

**High Specific Heat.** At normal temperatures and pressure, it requires one Btu to raise the temperature of one pound of water one degree Fahrenheit.

**High Coefficient of Heat Transfer.** The ability of water to cling to a metal surface, or wet the surface, reduces the resistance to heat transfer from one material to the other. As a comparison, when air cooling of an engine is used, fins are added to increase heat transfer surface area. Even then, air-cooled engines run hotter than water-cooled engines.

**Heat Control.** When water cooling is employed, an additional factor of safety is added to the engine. At normal atmospheric pressure, the temperature of the water cannot exceed 212 F.

In normal liquid-cooled engine, we have a flow similar to that shown in Fig. 2.

Cool water from the cooler enters the pump and is pumped into the cylinder jacket near the bottom of the jacket. This cool water begins to absorb heat as it rises around the cylinder and the farther it goes, the hotter it gets. This means that the top of the cylinder liner is hotter than the bottom. Under these conditions, the top of the liner expands more than the bottom and instead of being a perfect cylinder, the liner has the shape of a section of an inverted cone.

Many problems are introduced into engine operation because of this condition of temperature differential. Some of these problems are as follows:

**Poor Ring Fit.** If there is an appreciable difference between the cylinder diameter at top and bottom, the ring

The original presentation of this material by Sanders was before the Gas Compressor Institute, Liberal, Kansas.

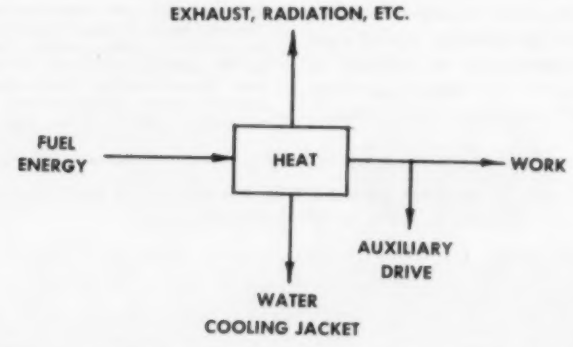


FIG. 1.

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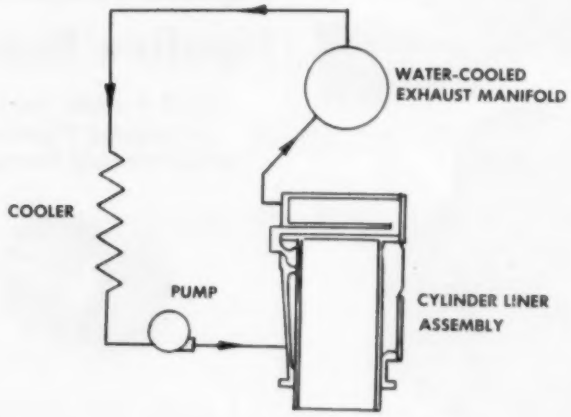
FIG. 2.




does not fit all parts of the stroke.

**Increased Blowby.** If the rings do not fit, they cannot seal properly.

**Friction and Wear Is Increased.**

**Increased Oil Consumption.**

**Increased Metal Stresses.**

To minimize the difficulties associated with unequal temperatures, engine manufacturers have used various methods to reduce the temperature differential across the engine. For example, instead of pumping 100 gpm through an engine and taking a 40-deg temperature rise in the water, they pump 400 gpm through the engine and reduce the temperature rise to 10 deg. Of course, there is an economic limit to the extent this method can be used.

Another method is to use a device in the law of heat transfer. This law states that the rate of heat transfer can be increased through a certain range if the velocity of the coolant over the heat transfer surface is increased. The water at the top of the liner is hotter than that at the bottom so a method of improving heat transfer at the top is needed. The method used is to install baffles in this section to reduce the cross-sectional area for fluid flow and thereby increase the velocity of coolant over the heat transfer surface. Although these baffles do the job, they restrict the flow of coolant and increase the pump power required. This is the cooling method used in most modern enclosed liquid-cooled engines.

If we bring water into the jacket at or near its boiling point — 212 F at atmospheric pressure — the temperature will rise only to the boiling point as it flows through the engine. Therefore, there is very little temperature difference in the water at the bottom of the liner and at the top of the liner.

If the temperature inside the cylinder is 1000 F and the water is at 212 F, heat must be transferred from inside the cylinder through the metal and into the water. The water temperature under atmospheric pressure cannot rise above 212 F, so the heat is absorbed by converting a portion of the water into steam but still providing a wetted surface of the jacket wall.

In addition to its other properties, as listed above, water has a high latent heat. The heat required to change 1 lb of water into a pound of steam at atmospheric pressure is approximately

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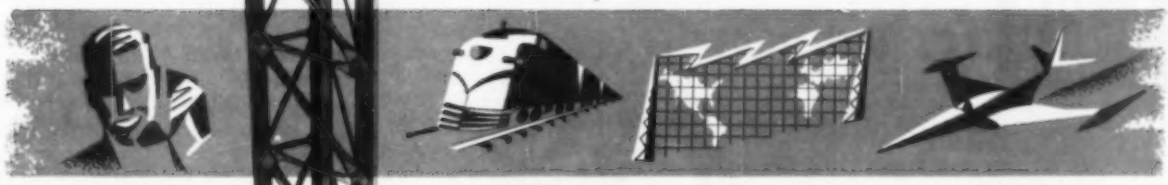

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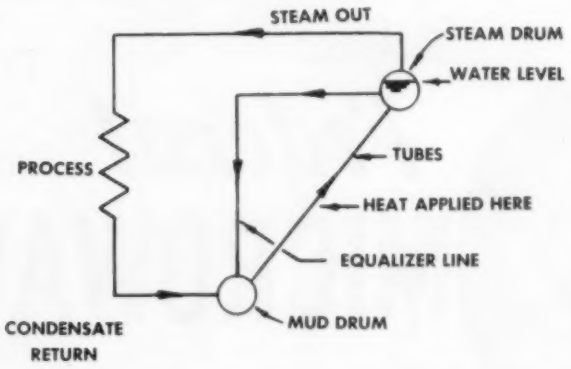
FIG. 3.





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970 Btu. Instead of pumping 97 lb of water through the unit and taking a 10-day temperature rise, you can theoretically do the same amount of cooling by evaporating 1 lb of water at no temperature rise. Instead of having water leave the engine, a mixture of steam and water results. Actually, the formation of steam forces a certain amount of water to leave the engine with the steam.

This method of cooling is called by several names, but probably the most popular one is *vapor-phase cooling.*

Vapor-phase cooling is not really "new" to the industry. In fact, many early engines used this method. In these units, water was piped from a supply into the water jacket and any steam that was formed was allowed to escape to atmosphere. Liquid cooling could not be much simpler than this .These old engines had a large jacket water passage that, no doubt, filled with sludge and scale in many cases because untreated make-up water was being added all the time.

### VPC Uses Closed-Cycle System

Modern vapor-phase units use the same type of cooling as these units. The major difference is that closed-cycle systems are in use. A closed cycle is one in which the steam is condensed and reused, thereby reducing the amount of make-up to normal leakage.

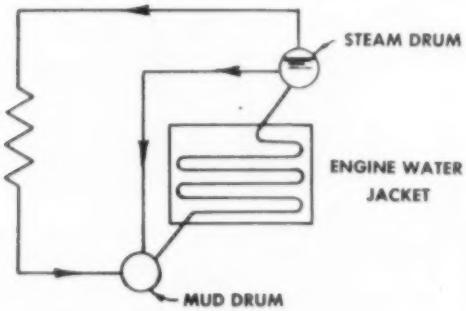
The vapor-phase system has many of the characteristics of a low-pressure water tube boiler. (See Fig. 3.) If this system is filled with cold water to the level shown and heat is applied as shown, the water inside the tube will aborb heat, expand, and because it is lighter than the cooler water, it will rise.

As it rises, it is replaced by cooler water from the lower drum; thus we get a thermal circulation. If enough heat is applied, the water will come up to the boiling point and change to steam, with the absorption of 970 Btu for each pound of steam formed if the system is at atmospheric pressure.

This same pound of steam, instead of occupying approximately 0.016 cu ft as water, now occupies 26.8 cu ft, an expansion ratio of 1674 to 1. From this ratio, even if only a small amount of water is changed to steam, the steam will occupy a large percentage of the volume in the tube. As steam has a negligible weight, the force causing flow in this system is the total head from water level in the top steam drum to the point where boiling occurs.

The steam that is formed may go to some process where part of the energy is utilized and where it is condensed and then is returned to the lower header. In a boiler of this type, it is

FIG. 4.




always necessary to keep water in the tubes or they will not be sufficiently cooled and will burn out. This is done by so designing the tubes and outside piping that the thermal head will cause more than enough flow to cool the tubes.

Now, if we replace the tubes between the two headers with the water jacket of an engine, we have practically the same thing as before. (See Fig. 4.) We still have heat being applied to the water between the drums and thermal circulation.

Utilizing the conventional present day liquid-cooled engine, there is one big difference. Instead of having a smooth wall tube with little resistance to flow, we have an engine jacket with tortuous flow patterns, deliberately put in by the manufacturers to improve the heat transfer with normal liquid cooling. To get the same amount of flow as with the tubes, we must either increase the pressure by the addition of a pump or reduce the resistance to flow both inside the jackets and in the outside piping.

## Must Reduce Restrictions

One reason for installing vapor-phase cooling is to eliminate the water pump. To do this, it is necessary to reduce the restrictions. As most of the difficult restrictions occur within the jacket of the engine, this is where the most changes must be made. The baffled sections may be reconnected with outside piping to place these sections in parallel instead of series, the outlet and inlet lines to the jacket can be increased in size and in some cases, part of the baffles may be removed. (See Fig. 5.)

As we can modify the standard engines so that thermal circulation is possible, what advantages can be obtained with this system? Two have already been mentioned: The reduction of temperature differences with a reduction of the defects caused by this difference, and the elimination of the water pump.

Following are some other advantages:

**Temperature Control.** Control valves and additional piping to maintain a constant temperature are not necessary. The temperature will remain at the boiling point at all times.

**Smaller Coolers.** As the coolant is at a higher temperature, the MTD is larger and less surface area is required.

**Waste Heat Use.** When low-pressure steam can be used for heating, for process work, or for use in driving the auxiliaries, this method of cooling provides a very inexpensive method of supplying this energy.

**Auxiliary Drives.** The low-pressure steam can be used to drive the auxiliaries such as cooling fans for the lube oil cooler and coolant condenser, thereby almost completely eliminating the auxiliary power energy losses shown on Fig. 1.

In 1953 it was necessary to install an addition to the United Gas Pipe Line Company's Agua Dulce, Texas, compressor station. This extension consists of five IR-880 hp KVG-8 compressor units. Although it was not planned to use low-pressure steam, it was decided to install vapor-phase cooling to secure its other advantages. Part of the equipment was purchased from a company that had considerable design experience and patents on parts of the process. This company recommended that a design for a flow of 18 lb of water with each pound of steam be used. The following are some of the calculations used in the design:

Heat rejection to C.W. at full load = 41,800 Btu/min.

Latent heat of water = 970 Btu/lb.

Then the lb/min water vaporized = 43.20 lb/min.

This equals $\frac{43.20}{8.33} = 5.18$ gpm of water converted to steam

This means that, under ideal conditions, a flow of 5.18 gpm would satisfactorily cool the engine. The conditions were anything but ideal, which accounts for the 18 to 1 ratio. Therefore, a design was used for the flow of 19 × 5.18 or 98.5 gpm of water into the engine and 93.5 gpm of water plus the steam generated by 5.18 lb of water leaving the engine. The approximate thermal head to cause flow was calculated and the lines to and from the unit were sized accordingly. Some additional connections were made on the unit to reduce the resistance of flow. After the engines were broken in according to the manufacturer's recommendations, the station was put on the line in January, 1954. ★ ★ ★

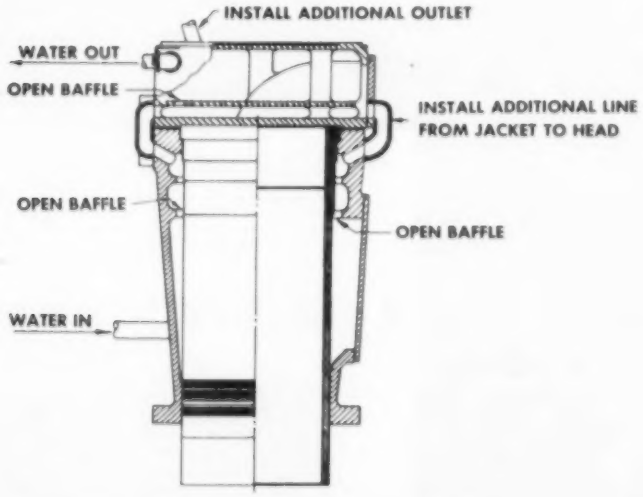
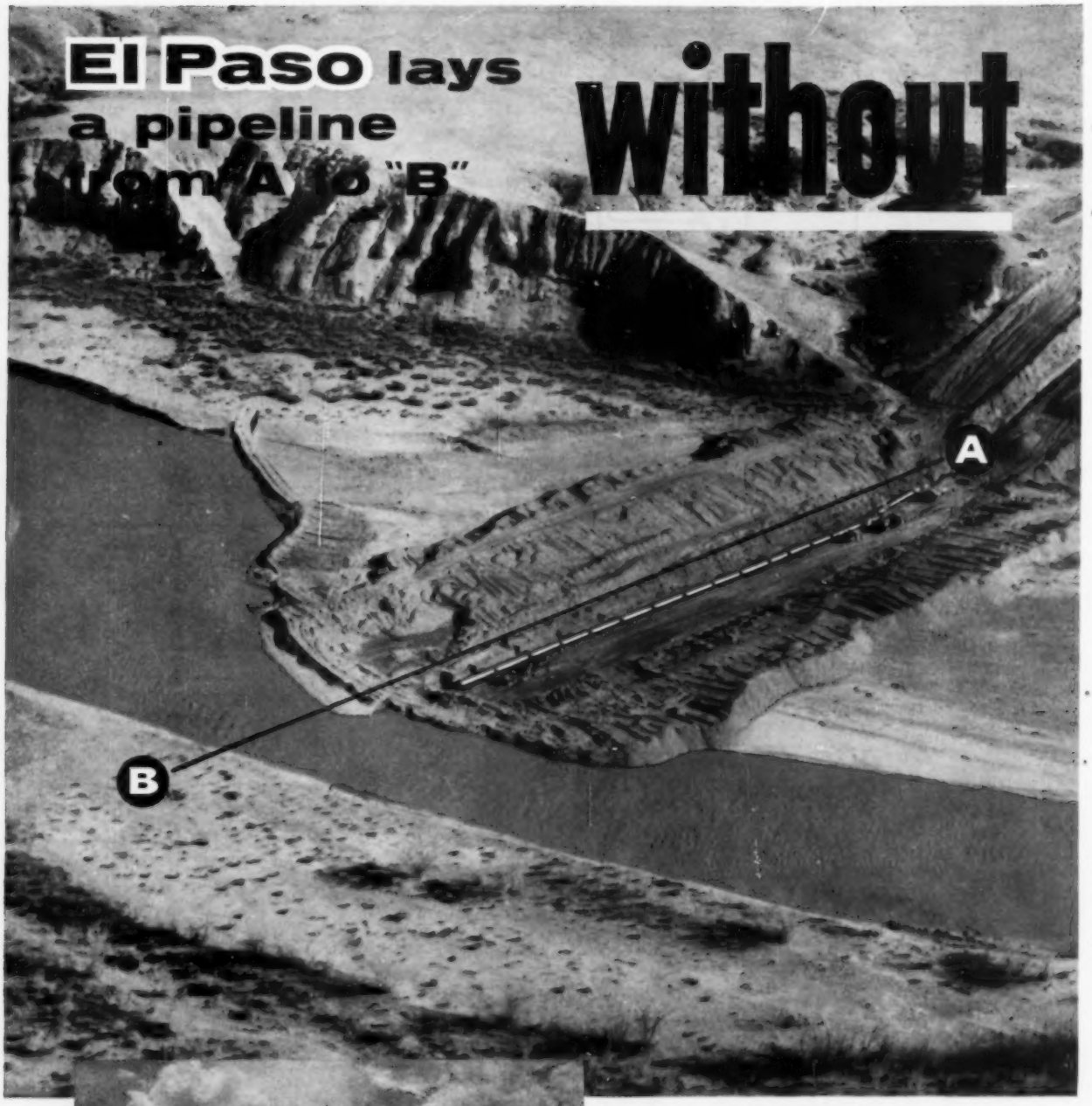



FIG. 5.

**The Author**

Glenn Sanders is an engineer with United Gas Pipe Line Company, Shreveport, Louisiana. He is a 1949 graduate of Louisiana Polytechnic Institute at Ruston. Joining United in March, 1952, he has been engaged in plant construction and design since that time.

# El Paso lays a pipeline from "A" to "B" without



El Paso spreads cross the San Juan river in northern New Mexico. Pipe was first laid to the edge of the main channel. Then an earthen dam was built upstream. Water flow shifted over the section of line near the far bank and the 800-foot crossing was completed. Trench depth averaged 20 feet, pipe was anchored every 40 feet with tie-down clamps bolted 9 feet deep in the shale.

Laying the 34-inch pipe across the red desert of the Navajo Indian Reservation of Northern New Mexico.

From San Juan, New Mexico, the line travels across the red desert of the Navajo Indian Reservation of Northern New Mexico and through the Foothills of the San Francisco Mountains in northern Arizona near Flagstaff. Near Holbrook, Arizona, it extends under the little Colorado River (approx. 500-ft. crossing). At its terminus, the line stretches 1,100 feet across the Colorado River on a pipeline suspension bridge being built jointly by El Paso and Pacific Gas and Electric Company.



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Taking approximately 350,000,000 cubic feet daily from the San Juan Basin and another 100,000,000 cubic feet from the Permian Basin, the San Juan-Topock project, as it's called, will increase the company's total deliveries to over two and one-third billion cubic feet daily. Begun in early 1956 and scheduled for completion in early 1957 the new line will supply an additional 350 million cubic feet daily to customers in California and an additional 100 million cubic feet daily to customers in Arizona, New Mexico, Texas and Nevada. The 34-inch line, for the most part, will loop two existing lines (24 and 30-inch) which extend from the San Juan Basin to Topock on the California border.

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## CANADIAN OUTLOOK:

# Biggest Construction Year

**Leslie Orr Rowland**

THE largest pipe line construction year in the history of the Canadian petroleum industry is assured for 1957, according to contracts that have been let, more pending for which appropriations and permits have been set up, and others that have been announced but will not be reduced to terms of construction awards until early in the new year.

The largest mainline construction job is the combined 30 and 34-in. natural gas line of Trans-Canada Pipe Lines, Ltd., which will be completed from the eastern Alberta gas fields to Winnipeg and on to the head of the Great Lakes at Port Arthur. Contracts were completed on the first two sections of 34-in. last summer and fall, comprising 220 miles. Four more sections, completing the 34-in. line, will be laid in 1957, and at least five sections making up the first 450 miles of 30-in. to the Lakehead.

Section three was awarded to Universal Pipe Lines, Ltd., for 80 miles, from Milepost 220 near Pense to Milepost 300 to Candiac, Saskatchewan. Section 4, to Dutton-Williams Brothers, Ltd., covers 99 miles from Milepost 300 to Milepost 399 at Miniota, Manitoba, where the line crosses the Assiniboine River for the first time. Price-Poole has Section 5, from Milepost 399.71 on the east side of the Miniota crossing to Milepost 498.33 near McGregor, Manitoba, a distance of 98.62 miles. This contractor is a joint venture firm organized by H. C. Price of Canada, Ltd., and Pool Construction Company, Ltd. Section 6 was awarded to Canadian Bechtel, Ltd., for 86.16 miles net, from Milepost 498.33 to Milepost 584.83, at Ile Des Chenes, Manitoba, the end of the 34-in. pipe, less the footage for the second crossing of the Assiniboine River southwest of Portage la Prairie and the crossing of the Red River 12 miles south of Winnipeg.

The first section of 30-in. line is 84.17 miles in length, from Milepost 584.83 to Milepost 669 at the Manitoba-Ontario boundary. Section distances for the rest of the 30-in. line have not yet been determined.

Work is in progress on clearing and grading right-of-way through the winter on the whole line as far as Winnipeg, and some pipe is being strung on Sec-

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tions 3 and 4. Pipe is being double-jointed for Section 6 in a yard set up at the beginning of December. It is planned to string as long as weather permits, in order to take advantage of frozen right-of-way, which will become impassable in the spring thaw.

### Inland Natural Line

The second major job also is a natural gas system, being laid for Inland Natural Gas Company, Ltd., by Dutton-Williams Brothers, Ltd., through the interior of British Columbia. This job, comprising 360 miles of main trunk line and 515 miles of laterals and local mains, for a total of 875 miles, is the biggest contract ever let in Canada to one contractor, and will be handled by three mainline spreads and at least two distribution system spreads. Work started in October and will be continued through the winter wherever weather permits, with pipe laying to be completed in the 1957 construction season. This line will distribute gas from the Westcoast Transmission Company mainline, of which approximately 200 miles will be laid in 1957 to finish the job.

The Westcoast work includes completion of contracts let at the beginning of 1956 to Canadian Bechtel, Ltd., Conyes Construction Company, and Mannix, Ltd. The Dutton-Williams section was completed in the fall of 1956.

In Ontario two major utility companies will construct substantial mileage of natural gas mainlines and local distribution systems. Union Gas Company of Canada, Ltd., has not yet let the contract for extension of its mainline to Hamilton, involving 130 miles of 16-in., with laterals to several small cities and large towns along its route. Consumers' Gas Company will continue its expansion in the Toronto urban area with an indefinite but large program that will probably comprise at least 100 miles of new mains and services.

Saskatchewan Power Corporation has plans tentatively set up for extensions to its domestic system in the province. This program will include at least 100 miles of new mainlines, from Regina to Weyburn and Estevan, from the Hatton gas field to Success, and from Hatton to Maple Creek. The latter two lines will complete the integration of the grid in the western half of the province and will tie in the Hatton reserves with those at Brock-Coleville and Success to provide for reciprocal movement of gas when required. At least another 100 miles will be laid in laterals and local distribution systems for towns along these routes.

### Two Interprovincial Jobs

Oil pipe line construction includes two big jobs for Interprovincial Pipe Line Company. In Ontario a 150-mile 20-in. line will be laid from the present terminus of the mainline at Sarnia to the Toronto area. The contract is expected to be awarded in January. On the western portion of its line, Interprovincial will construct loops for a total of about 140 miles in Manitoba and Minnesota, to fill in the remaining gaps in the loop of its original line. The 1957 construction will increase the capacity of the line between Cromer, Manitoba, and Clearbrook, Minnesota, to provide for increased flow out of the Westspur pipe line from southeastern Saskatchewan fields. These contracts will be let during the winter.

Westspur Pipe Line Company is planning a loop of its mainline which was laid only last summer. The 78-mile loop will be of 16-in. pipe. Westspur also intends to lay 54 miles of 12-in. trunk line and smaller gathering lines to serve newly developed fields off the route of its present mainline. Engineering is not complete yet on the composite project, and contracts will not be let until January or later. Extensive additions to field gathering systems will

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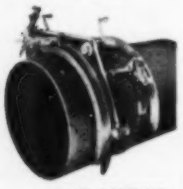

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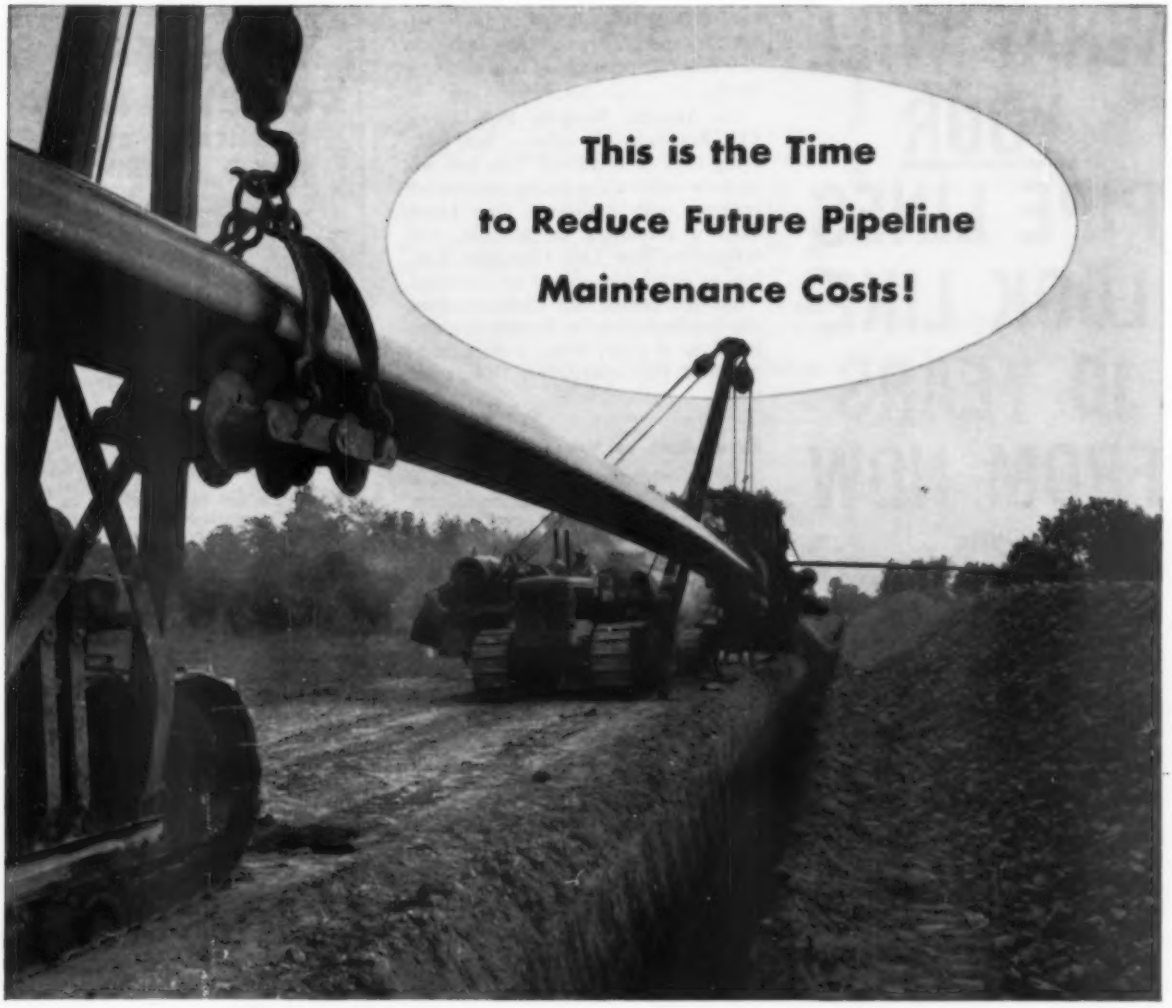


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take at least 100 miles of small-diameter lines and may run as high as 200 to 250 miles, depending on field development.

In Alberta, Pembina Pipe Lines, Ltd., has about 150 miles of field gathering lines to construct. This job will be done under a continuing open-ended contract with Universal Pipe Lines, Ltd., a subsidiary of Mannix, Ltd. Rangeland Pipe Line Company, Ltd., has an extension project to construct, which will consist of a 12-in. line from the Sundre field to its present southern terminus at Gilby West, a distance of 45 miles. This contract will be awarded soon.

### Extensions to Westspur

Of an undetermined but extensive mileage will be the various extensions to the Westspur Pipe Line Company system, which will have to be laid in 1957 to accommodate oil from fields and pools now under active development in southeastern Saskatchewan. These fields will be sufficiently defined by early in the year to justify pipe line connections. This phenomenal discovery region has had a higher success ratio in wildcat drilling, over a longer period of time, than any other part of the Western Canada sedimentary basin. The areas of substantial oil accumulation are spreading out far beyond the present limits of the pipe line system, and it would be a fair estimate to look for another 100 to 150 miles of gathering systems and extensions to be laid in 1957 to serve these pools.

Both principal utility companies in Alberta will be extending their natural gas services, following up a large program of 1956 construction. No detailed plans have been announced, but the combined mileage for Canadian Western Natural Gas Company, Ltd., and Northwestern Utilities, Ltd., should exceed 100 miles.

Among the smaller Alberta gas jobs will be the first stage of construction of the gas grid system for The Alberta Gas Trunk Line Company, Ltd., in the eastern Bindloss field, probably the only field to be tied to the Trans-Canada system in 1957. This section of an eventual 250-mile grid, will be only 25 miles of combined 20 and 34-in. mainlines, with a few small laterals. It will run from the Bindloss field in the Alberta gate to the Alberta-Saskatchewan border. A contract will be completed during the winter on the crossing of the Saskatchewan River, by Universal Pipe Lines, Ltd., but the mainline construction contract is still pending. Only a very great enlargement of the Trans-Canada market, not now in sight, could necessitate any more Alberta Grid construction in the coming year. ★ ★ ★


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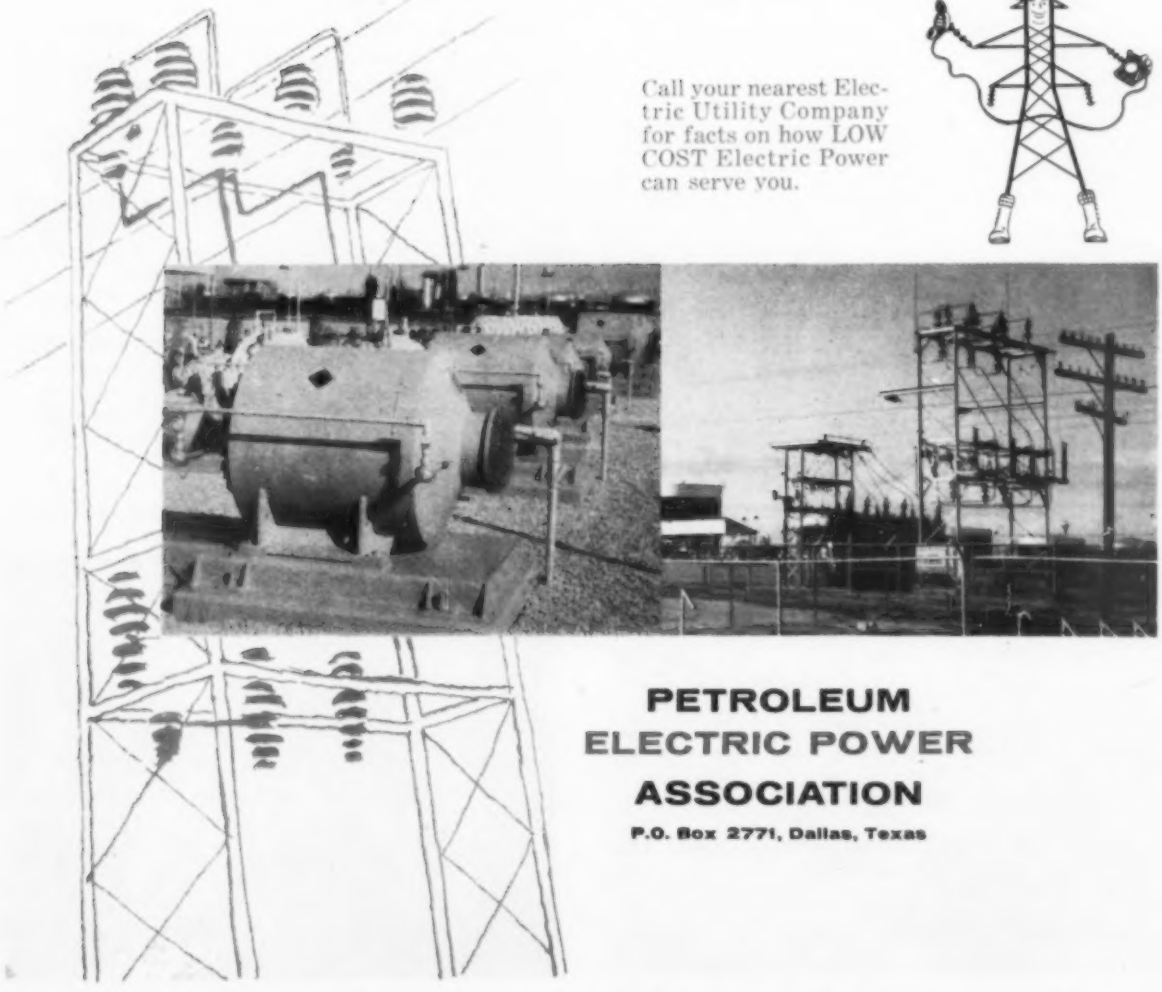

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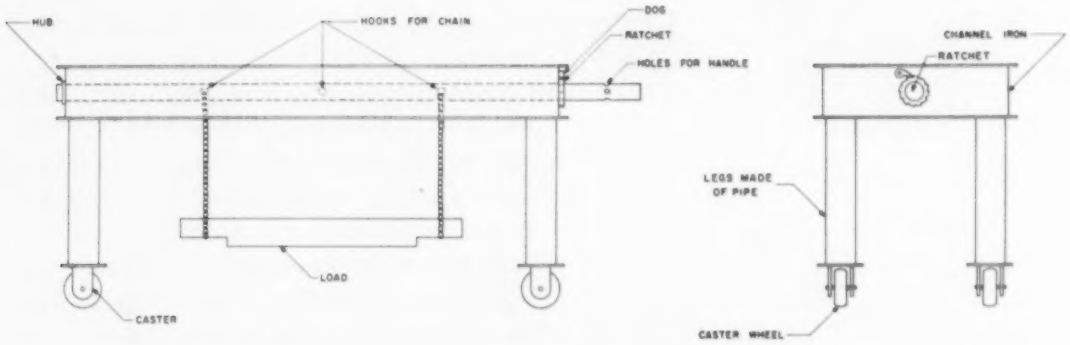
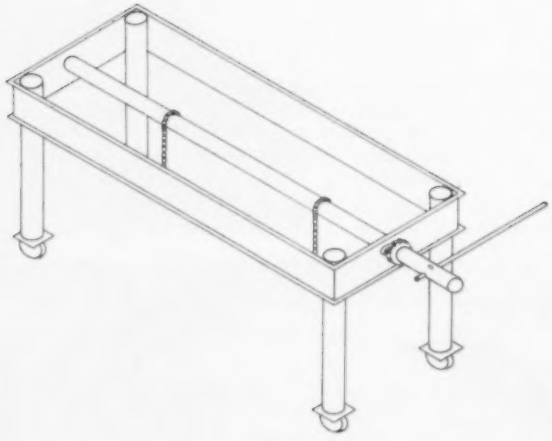


## Portable Shop Table that Also Serves as Portable Hoist

Here is a portable shop table with a steel plate top that can also serve as a portable hoist for heavy valves, flanges, etc., that must be moved about the shop.

The table is the conventional kind found in many shops; it has pipe legs, rubber-tired casters, a channel iron frame, and a steel plate top. To give it the added feature of being a heavy duty portable hoist, simply run a piece of 4-in. pipe from end-to-end, weld a ratchet to the pipe and channel iron at one end, and drill holes through the pipe that will fit a cheater. Then weld hooks to the pipe so a light chain can be attached to the pipe.

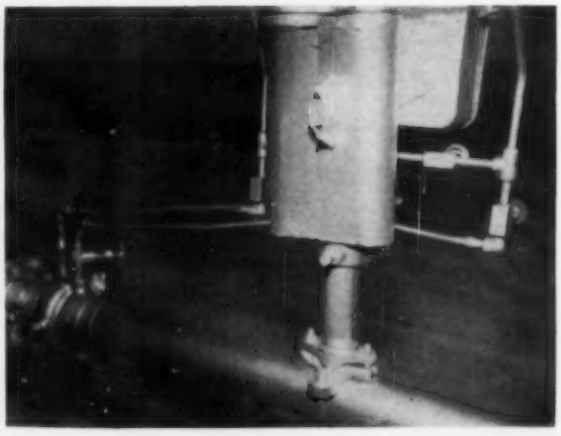
Loop the chain around the load and winch it free of the floor by turning the pipe with the cheater. Then move the load by rolling the table. Care should be used to insure that there is sufficient clearance between the bottom of the table top and the pipe to allow several wraps of chain to be taken up.

## Ingenious Locking Device Prevents Theft of Mercury from Field Instrument

A long-shackled bicycle padlock was used by one company to support a guard around the manometer to solve the problem of theft of mercury from field orifice meters. The guard was made of sheet steel, field formed to enclose the manometer section of the meter. A recepticle welded to it houses the lock (which is completely detachable from the shackle). Holes for the shackle were bored through the instrument yoke.

To install the cover, slip it up over the manometer, run the shackle through the holes and press the lock onto the shackle on opposite sides.

To remove the guard, unlock the bottom section of the padlock and remove it; force the shackle out on opposite side and the cover drops down from the manometer.



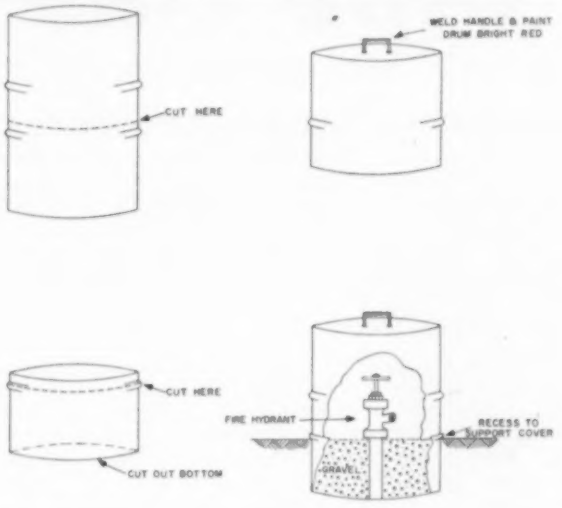
## Protect Bibs and Hydrants

Make a cover from an old oil drum, paint it red and use it to protect hose bibs and fire hydrants in the plant yard. Trucks, power mowers, tractors, etc., are hazards insofar as the hydrants are concerned and a cover not only serves as a warning to the operators, but also guards against freezing in the winter.

Cut a drum in two, braze or weld a handle on one end, and paint it bright red. Be sure to cut the drum at a point where its diameter is smallest, because the base must be made from the remainder of the drum, and the cover must fit inside it.

To make the base, cut the drum at mid-point on one of the ribs. This greater diameter will allow the upper portion to fit inside the base. Cut the end out of the base, imbed it in the earth around the hydrant, and fill it almost level with gravel. The cover will fit inside it.

Where winters are severe, the cover can be filled with cork chips or other insulating material to prevent freezing.



## Mount Part of Old Auto Body Onto Jeep for Cold Weather Field Car

It's the darndest looking thing you ever saw; drive it up among a group of strangers and you'll find it an easy matter to start a conversation — to say the least. Yet despite its strange appearance, it furnishes protection from the elements in both cold weather and hot.

Simply cut a portion of an old auto body as shown, bolt it onto the top of the jeep and you have converted a jeep into a convertible — or is it a coupé?

## Sideboom Backfiller Made From Old Jeep

A rig for handling pipe with an army jeep may be made by installing a sideboom and winch. The sideboom is made of 2-in. pipe with a clevis on each end to attach to the outside of the frame. The tops of the pipes are hinged so that the pins at the bottom can be pulled and the unit easily dismounted. The usual "hairpin" connection in the top is used to carry the snatch block.

A truck winch is then mounted on the front of the bed with power take off from the driveshaft. The winch line is threaded through the snatch block on top of the gin poles.

Another power takeoff is connected to the cathead mounted on the back of the jeep for use in backfilling. The mormon board is attached to the line over the gin poles and the cathead is used to give the forward motion.

# Pipe Line Projects

## Hearings Begin in January on $200,000,000 Construction

The Federal Power Commission has scheduled hearings to begin January 7 in Washington, D. C., on applications by five companies proposing the construction of natural gas transmission facilities, in the west and midwestern sections of the United States, having a combined estimated cost of $200,000,000.

The commission previously had consolidated the applications for hearings, which were to have begun October 2, but prior to their commencement they were postponed until further notice.

The proceedings involve applications by Natural Gas Pipeline Company of America and Texas Illinois Natural Gas Pipeline Company, both of Chicago, Illinois; Chicago District Pipeline Company, Joliet, Illinois; Pacific Northwest Pipeline Corporation, Salt Lake City, Utah, and Colorado Interstate Gas Company, Colorado Springs.

Pacific Northwest's application involves the sale of additional natural gas to Colorado Interstate, while the latter company, among other things, is seeking authority to sell additional gas to Natural. Natural, Texas Illinois, and Chicago District, subsidiaries of the Peoples Gas Light and Coke Company, serve Chicago and other midwestern areas.

In a concurrent order, the FPC separated from the consolidated proceedings a second application by Pacific Northwest, involving the sale of natural gas to Mountain Fuel Supply Company, Salt Lake City, Utah. The commission then consolidated this application with one by Mountain Fuel for hearings to begin at a date to be set later. Mountain Fuel's application involves a pipe line project in Wyoming, estimated to cost $3,159,100. The company has already received temporary authority from the FPC for the construction and operation of its facilities, and Pacific Northwest has temporary authorization for the construction of the facilities needed to make the sale to Mountain Fuel.

## El Paso Changes Plans For South Andrews Field

The Federal Power Commission has granted El Paso Natural Gas Company, El Paso, Texas, temporary authorization to construct and operate natural gas facilities in the South Andrews field, Andrews County, Texas.

FPC also canceled the temporary authority issued to El Paso on June 27 at the request of the company. This authorization covered approximately 65 miles of gathering lines; a 2640-hp compressor station plus field compression of approximately 440 hp; 16 miles of 20-in. line; 16 miles of 4½-in. liquid products pipe line; 11 miles of 4½-in. fuel line; a gasoline plant, with a capacity of 20,000,000 cu ft per day, and metering and appurtenant facilities.

El Paso told the commission that it no longer required the construction of the gasoline plant.

In lieu of the gasoline plant, the 16 miles of 20-in. line and the 16 miles of 4½-in. line, El Paso now proposes to lay approximately 22.5 miles of 20-in. line from the South Andrews field booster station to Shell's plant; 8.5 miles of 16-in. line from the Shell plant to El Paso's Goldsmith compressor station, and piping changes at the Goldsmith station. The replacing facilities, together with the other South Andrews facilities, are those for which temporary authorization was granted.

## Kansas-Nebraska to Deliver Gas from Camerick Field

Kansas-Nebraska Natural Gas Company of Phillipsburg, Kansas, and Northern Natural Gas Company, Omaha, Nebraska, have been authorized by the Federal Power Commission to construct and operate facilities necessary for the sale of natural gas from the Camerick field, Texas County, Oklahoma, by Kansas-Nebraska to Northern.

Kansas-Nebraska proposes to construct 61.3 miles of various diameter gathering lines and measuring equipment from the Camerick field to Northern's Liberal, Kansas, station at an estimated cost of $1,426,100. Northern's minor adjustments to its Liberal station to enable it to receive the additional gas are estimated to cost $3600.

Kansas-Nebraska recently acquired 321,284,345,000 cu ft of reserves in the Camerick field.

## $9,440,000 Line Planned

Pacific Gas & Electric Company, San Francisco, has applied to the California Public Utilities Commission for permission to construct a 173-mile transmission line from the Sacramento Valley into Humboldt County. Cost of the line is estimated at $9,440,000 and it would be ready for operation in the summer of 1958. Gas supplies would be from Beehive Bend and Perkins Lake fields.

## Full Hearing to Be Held On Midwestern Application

The Federal Power Commission has affirmed a recommended decision by one of its presiding examiners denying a series of motions seeking to dismiss applications by three pipe line companies involving the proposed import and export of natural gas from and to Canada and the construction of a pipe line system in the midwestern part of the United States.

The motions sought dismissal of applications by Midwestern Gas Transmission Company and Tennessee Gas Transmission Company, both of Houston, Texas, and Iron Ranges Natural Gas Company, St. Paul, Minnesota.

Midwestern is seeking authority to build a pipe line system extending from a connection with Tennessee's system near Portland, Tennessee, to a point on the U. S.-Canadian border where it would receive one-half of its gas supply, or 204,000,000 cu ft of natural gas per day, from Trans-Canada Pipe Lines, Ltd., near Emerson, Manitoba. The other 204,000,000 cu ft daily would be purchased from Tennessee at the Portland connection. Tennessee, in addition to the proposed sale to Midwestern, is seeking authorization to sell up to 48,000,000 cu ft daily to Trans-Canada near Niagara Falls, New York, on a short term basis pending completion of Trans-Canada's system across Canada. Iron Ranges would build pipe line facilities in Minnesota, to transport and sell gas it would receive from Midwestern.

## Approval of Florida Gas Line Looked For Soon

Speeded-up action can be looked for in plans for a pipe line to take gas into Florida, which until now has no natural gas service. The Federal Power Commission has ordered omission of the examiner's intermediate decision and oral argument. This clears the way for rapid action.

Coastal Transmission Corporation is seeking permission to lay a 574-mile line originating in Texas, which will deliver gas at Baton Rouge, Louisiana, to Houston Texas Gas and Oil Corporation. The latter's plans call for a 943-mile mainline and 683 miles of laterals.

In making its decision FPC cited appeals for approval from officials of the State of Florida, the Florida Railroad and Public Utilities Commission, the Orlando Utilities Commission, and officials of numerous municipalities.

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## Cities Service Plans 60-Mile Oklahoma Line

The Federal Power Commission has granted temporary authority to Cities Service Gas Company, Oklahoma City, Oklahoma, for the construction and operation of approximately 60 miles of natural gas pipe line in the Eureka area in Grant and Alfalfa counties, Oklahoma, at an estimated cost of $1,288,600.

The facilities for which the temporary authorization was issued consist of 37 miles of 4-in.; eight miles of 6-in.; eight miles of 10-in.; four miles of 8-in., and three miles of 12-in. line.

## Natural Gas Pipeline to Lay 350-Mile Line

The Federal Power Commission has authorized Natural Gas Pipeline Company of America, Chicago, Illinois, to construct a 350-mile pipe line to tap reserves in northern Texas and southwestern Oklahoma. Delivery will be to the Chicago area.

The commission at the same time issued a certificate to Lone Star Gas Company, of Dallas, Texas, authorizing it to sell a maximum of 100,000,000 cu ft of gas per day to Natural at a point in Stevens County, Oklahoma, although it denied Lone Star's proposal to build a 230-mile line to make this gas available to Natural at Fritch, Texas. Natural's proposed line will intersect Lone Star's system at the point in Stevens County.

Natural's proposed 350-mile line will extend from Wise County to a connection with its existing system at Fritch. Natural plans to obtain additional gas from points along the route of the new line, which will have a capacity of 240,000,000 cu ft per day. Estimated cost is $28,487,000.

## 150-Mile Pipe Line Will Bypass Suez

An 8-in. 150-mile pipe line to move crude oil north from the Gulf of Aqaba, Israel, to a terminus at Negev, Beersheba, has been announced. From that point the crude will be transported by rail to Haifa refineries.

The pipe line will facilitate imports from the Persian Gulf without requiring passage through the Suez Canal. According to reports, construction already is underway, with 90 to 120 days needed for completion. French engineers are serving as technical advisers.

## Rangeland Gets Permit for Oil Line in Canada

Rangeland Pipe Line Company, Ltd., has received permission by the Alberta Conservation Board to lay 46.5 miles of 12-in. crude oil pipe line. The line will connect the northern end of the Sundre oil field, 70 miles northwest of Calgary, with the present terminus of the Rangeland mainline at the Gilby West oil field, north by east of Sundre. The pipe line company is owned by Hudson's Bay Oil and Gas Company, Ltd., which also controls nearly all Sundre production.

## Bolivian Pipe Line Closer to Reality

Bolivian Gulf Oil Company has signed a contract with Yacimientos Petroliferos Fiscales Bolivianos, the government oil company, to help finance a pipe line from producing areas, now having no outlet, to the Pacific Coast, or, as an alternative, to the Atlantic Coast.

A Supreme Decree that made it possible for YPFB to sign the contract with Gulf has now become a law. First choice is for the pipe line to extend from Sicasica, Bolivia, to Arica, Chile. Construction of the line over this route will require an international agreement between Bolivia and Chile. An alternate route has been approved should this agreement not be concluded by November 15, 1957, in which event the line would terminate on the Atlantic Coast.

## Trans Mountain Has Further Expansion Plans

The expansion program of the Trans Mountain Oil Pipe Line Company, now under study, involves the development of the system beyond the 200,000-bbl daily capacity rate that will be attained by completion of the permanent pumping stations at Jasper and Gainford in 1957.

With a view to the probable development of the system to a capacity exceeding 300,000 bbl daily the next steps under consideration in the company's expansion program include a start on a looping program with a concentration of pumping capacity at larger pump stations on an ultimate double line rather than a multiplicity of smaller pump stations on the single, original, 24-in. line.

The first stage of the program now under consideration includes partial looping of the line by paralleling certain sections. Present plans include additional station and tank farm facilities to give the system a capacity of 240,000 bbl daily by August, 1957, and allow flexibility in deliveries to refineries in British Columbia, and Washington, and for offshore shipments.

## Lau Bach Named

Neal B. Lau Bach has been made vice president in charge of operations by Colorado Interstate Gas Company. He is now vice president with the Hudson Engineering Corporation, Houston, Texas.

## Ohio Fuel Company To Lay Short Line

The Federal Power Commission has authorized The Ohio Fuel Gas Company, Columbus, Ohio, to construct and operate natural gas facilities in Ohio to cost an estimated $772,360.

Ohio Fuel will construct about 18.8 miles of 5-in., 12-in., and 16-in. pipe line, replacing or looping existing facilities to serve the increased requirements of existing markets in the Dayton and Toledo areas, and the extension of service to one small new market, McCutchenville.

The FPC also authorized Ohio Fuel to abandon 7.7 miles of pipe line that the authorized construction would replace.

Ohio Fuel also has been authorized to construct additions to its Crawford, Ohio, compressor station, estimated to cost $850,000. Two additional 1500-hp compressor units will be installed, increasing the station's capacity to 15,050 hp.

## Permian Plans Line to Tie-In New Gas Supply

Permian Basin Pipeline Company, Omaha, Nebraska, has filed an application with the Federal Power Commission requesting authority to build the necessary facilities to take gas from Pioneer Gathering System, Inc. in the West Central Texas area.

John M. Hanley, vice president in charge of gas supply for both Permian and its parent company, Northern Natural Gas Company, stated that Permian has entered into a contract with Pioneer calling for deliveries of gas from Pioneer at a point in Schleicher County, Texas.

In its application, Permian points out that it will construct 83 miles of 16-in. pipe line from existing facilities near its Spraberry compressor station in Midland County, Texas, southeastward to tie-in with Pioneer's system at a point in the northwestern portion of Schleicher County. Permian also will construct a 3960-hp compressor station in Schleicher County. Permian's proposed additional facilities will cost an estimated $5,000,000.

Permian's contract with Pioneer calls for deliveries of gas in amounts of up to 200,000,000 cu ft a day. Initial deliveries, scheduled to begin in 1957, will be in excess of 50,000,000 cu ft a day.

Hanley explained that this will permit Permian to expand into a new area of gas supply. Permian, in turn, will utilize this additional supply of gas to maintain its sales to its parent company, Northern Natural Gas Company.

## WITH THE

# PIPE LINE CONTRACTORS

● **Dutton-Williams Bros., Ltd., North Canadian Oils Building, Calgary, Alberta.** Has 320 miles of 10 through 4-in. distribution systems for *Inland Natural Gas Company* in Nelson, Savona, and Penticton, central British Columbia.

● **R. H. Fulton & Company, Inc., P. O. Box 1526, Lubbock, Texas.** Has 252 miles of 22-in. line for *Colorado Interstate Gas Company* between Rock Springs and Laramie, Wyoming.

● **Oklahoma Pipe Line Contractors, 6612 Hines Blvd., Dallas 20, Texas.** Has 327 miles of 18-in. line for *Plantation Pipe Line Company* between Baton Rouge, Louisiana, and Helena, Alabama. Has 74 miles of 6-in. for *Tennessee Gas Transmission Company* between the Brazos River near West Columbia, Texas, and Lavaca Bay.

● **H. C. Price Company, Box 1111, Bartlesville, Oklahoma.** Has 246 miles of 30-in. natural gas line from Hancock County, Indiana, to Slaughters, Kentucky, as part of a joint venture with Houston Contracting Company on 783 miles of 30-in. for *American-Louisiana Pipe Line Company* from Willow Run, Michigan, to the Arkansas state line near Eudora, Arkansas. Also has 82 miles of 26-in. line for *Tennessee Gas Transmission Company* near Chauncey, Ohio.

● **Sheehan Pipe Line Construction Company, 514 National Bank of Tulsa Bldg., Tulsa, Oklahoma.** Has 75 miles of 8-in. take-up for *Sun Pipe Line Company* between Marcus Hook, Pennsylvania, and Plainfield, New Jersey.

● **Trojan Construction Company, Inc., 1416 N. Robinson, Oklahoma City 3, Oklahoma.** Has contract for takeup and reconditioning 276 miles of 8-in. line for *Sinclair Pipe Line Company* between Jacksboro and Mexia, Texas.

● **Lone Star Constructors, 10301 Shady Trail, Dallas, Texas.** Has 94 miles of 18-in. line for *Humble Pipe Line Company* from its Ector Station to the Kemper Station, in West Texas.

● **Latex Construction Company of Georgia, P. O. Box 184, Fond du Lac, Wisconsin.** Has 90 miles of 16 and 20-in. line between Oshkosh and Milwaukee, Wisconsin for *Michigan-Wisconsin Pipe Line Company*.

● **Missouri Valley Dredging Company, 222 William Street, Omaha, Nebraska.** Has three major crossings on *Sun Pipe Line Company's* 109-mile new products line between Twin Oaks, Pennsylvania, and Newark, New Jersey; the crossings are on the Schuylkill, Delaware and Raritan rivers.

● **Mannix, Ltd., 332 7th Avenue W., Calgary, Alberta.** Has 110 miles of 30-in. gas line at the south end of *Westcoast Transmission Company's* gas line from Peace River area, Alberta, to U. S.-Canadian border near Vancouver, British Columbia. Has 90 miles of 34-in. gas line for *Trans-Canada Pipe Lines, Ltd.*, between Moose Jaw and Wolseley, Saskatchewan. Has partially completed laying a 300 mile, 3 to 16-in. crude gathering line for Pembina Pipe Line, Ltd. Has undetermined amounts of 24-in. line to lay for *Trans Mountain Pipe Line Company, Ltd.*, between Hope and Vancouver, British Columbia, due to relocation of various sections due to new highway construction. Also has 2600 ft of 18-in. submerged line for *Alberta Gas Trunk Line Company, Ltd.*, to lay across Red Deer River near Blindloss, Alberta.

● **Somerville Construction Company, Ada, Michigan.** Has 67 miles of 10 and 12-in. line from Clare County to Traverse City, Michigan, for *Michigan Consolidated Gas Company*. Also has 60 miles of 10 and 12-in. line between Muskegon and Ludington, Michigan, for the same company.

● **Hunsaker Trucking Contractor, Inc., P. O. Box 97, Carrollton, Texas.** Has subcontract for stringing 94 miles of 18-in. line for *Humble Pipe Line Company* between Odessa and Big Lake, via Crane, Texas. Lone Star Constructors, Dallas, is prime contractor.

● **H. B. Zachry Company, Box 2570, San Antonio 6, Texas.** Has 330,000 ft of 4½-in. line for *Phillips Petroleum Company* between Coke County and Midland County, Texas. Has three spreads of 30-in. line and river crossings for *Texas Eastern Transmission Corporation*. One spread of 353,700 ft extends from the Rio Grande River to the King Ranch; another, 358,500 ft between Port Lavaca and Highway 35. The river crossings are on the Rio Grande between McAllen and Vidor, Texas.

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## Pipe Line Contractors

● **Hallmac Construction Company, 3701 Buffalo Drive, Houston 19, Texas.** Has 400 miles of 24 to ¾-in. line for Spokane *Fuel and Gas Company* for natural gas distribution system within the city of Spokane, Washington. Job closed down for the winter.

● **Western Construction Company, P. O. Box 798, Austin 64, Texas.** Has 12 miles of 30-in. for *Transcontinental Gas Pipe Line Corporation* between Scottsville and Charlottesville, Virginia. Also has contract for a 30-in. Susquehanna River crossing for the same company.

● **Panama-Williams Corporation, 1418 Melrose Building, Houston, Texas.** Has 76 miles of 4 and 6-in. line for *Phillips Chemical Company* between Pasadena and Sweeny, Texas.

● **Holdren Construction Company, P. O. Box 417, Mount Vernon, Illinois.** Has 12 miles of 3-in. line to lay for *Town Gas Company of Illinois* extending from the Panhandle-Eastern line below Auburn to Girard, Illinois. Also has 42 miles of small distribution lines to lay for the same company in the cities of Virden, Girard, and Thayer, Illinois.

● **M. G. M. Construction Company, P. O. Box, 1056, Concord, California.** Has 25 miles of 6-in. for *Pacific Gas & Electric Company* from San Ardo gas fields to King City, California.

● **Majestic Contractors Limited, 408 Royal Trust Building, Edmonton, Alberta.** Has gathering system to lay for *Westspur Pipeline* in the Midale, Saskatchewan, area. Has undetermined amount of city distribution system for *Consumer Gas Company* in Toronto.

● **Collins Construction Company, Box 86, Port Lavaca, Texas.** Has contract with *U. S. Government Agencies in Europe* to lay 8000 ft of 24-in. sea-loading line in Bay of Biscay. Also has 37,000 ft of 22-in. submarine pipe line installations to lay for the *City of Los Angeles*, California. The installation, the Hyperion sludge line, extends from the beach near El Segundo to a depth of 300 ft offshore.

● **Ross-Powers Construction Company, Box 2038, Billings, Montana.** Has 40 miles of 12-in. line for *Montana-Dakota Utilities Company* between Baker and Glendive, Montana. Also has 10 miles of 6-in. to lay eastward from Cabin Creek, Montana, for the same company.

● **Fulton Banister Ltd., 625 Northern Hardware Building, Edmonton, Alberta.** Has 18 miles of 6-in. line to lay for *Mid-Western Gas Ltd.*, between Redwater and Fort Saskatchewan, Alberta.

● **Engineering-Construction Company, 407 First National Building, Tulsa, Oklahoma.** Has undetermined amount of 1¼ through 8-in. city distribution lines in the town of Brookings, South Dakota, for *Northwest Public Service Company*.

● **Houston Contracting Company, 2707 Ferndale Place, Houston 6, Texas.** Has 121 miles of 30-in. natural gas pipe line for *Texas Eastern Transmission Corporation* from a point near Angleton, Texas, east to a point near Vidor, Texas. Work to start about March 1, 1957, based on receipt of pipe and materials.

### Two More Contracts Let By Trans-Canada Pipe Lines

Two more contracts have been let for construction work on the 34-in. natural gas pipe line of Trans-Canada Pipe Lines, Ltd., between the Alberta gate and a point southeast of Winnipeg where the 34-in. line terminates. Price-Poole has the 98.62 miles on section five, from the east side of the Assiniboine River crossing at Miniota, to a point just north of McGregor. Clearing and grading right-of-way on this section started on November 3 and was scheduled to continue as long as weather permits. Pipe laying will not start until next summer after road bans are off. Clarence Shivel is spread superintendent.

Canadian Bechtel, Ltd., has been awarded section six, which contains 86.16 miles net, from McGregor to Ile des Chenes, 15 miles southeast of Winnipeg. The net mileage excludes two river crossings that are being constructed separately. Clearing and grading have also started on this section.

Bechtel also is double-jointing pipe in a portable yard that is used on section two in the summer, in Saskatchewan. Pipe will be strung through the winter, as weather permits, by Canadian Parkhill Pipe Stringing, Ltd., which has set up an office in Portage la Prairie. The Bechtel spread will be under general direction of superintendent Joe Work. Art Rigby is in charge of the double-jointing yard.

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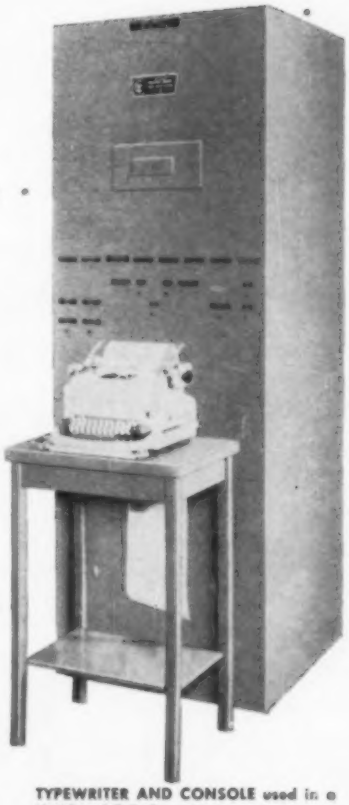

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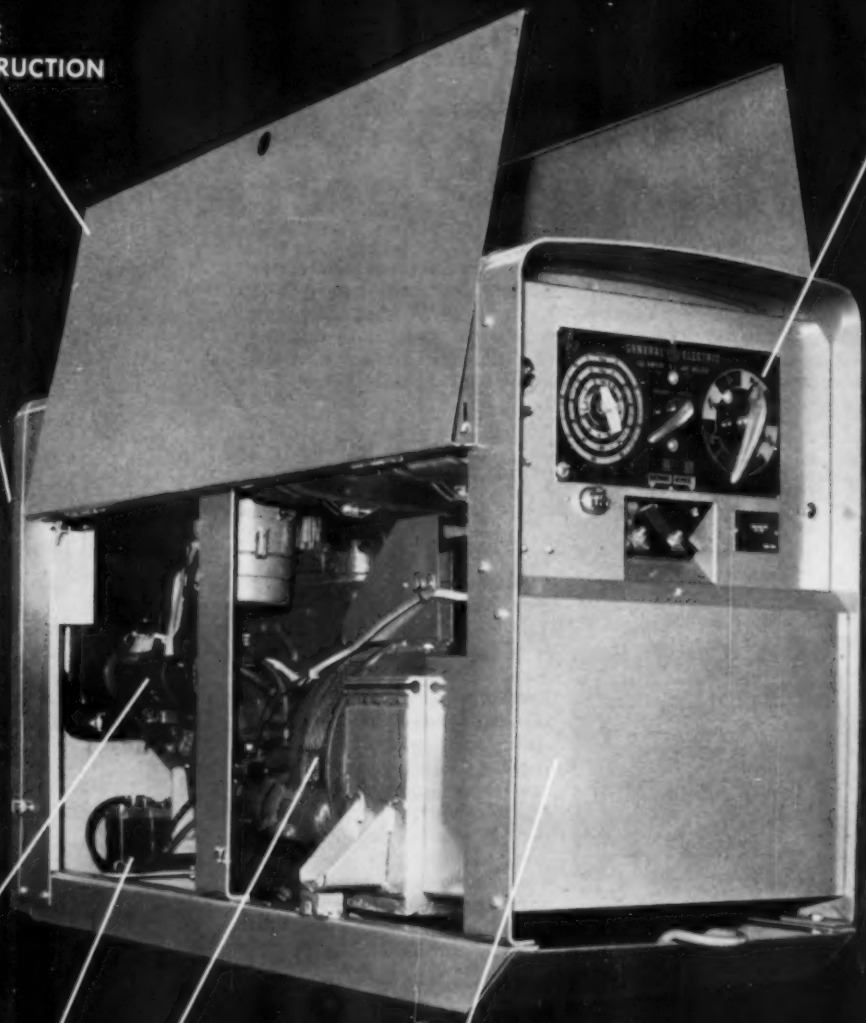


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## Advanced design assures less "downtime," minimum maintenance—for faster, lower-cost welding

Nothing stretches out construction time more than unreliable or obsolete equipment. Such equipment increases your maintenance costs and results in nonproductive "downtime." It may even lead to contract fines and loss of repeat business.

**To reduce construction delays,** General Electric's new line of engine-driven welders has been designed and field-tested for maximum durability and minimum maintenance—without sacrifice in performance. These new 200-, 300-, and 400-amp welders save for you with the following advantages:

**SAVE YOU TIME**—Sturdy construction, the dependable Hercules engine, new-design generator, and simplified control all combine to give you steady output, longer operating time between overhauls, and reduced maintenance. This means more production per machine . . . per man-hour.

**SAVE YOU MONEY**—General Electric engine-driven welders begin saving you money the first day on the job. For example, the deep-sump crankcase provides complete lubrication to all moving engine parts—up to a 15-degree tilt in any direction. This helps to reduce costly breakdowns. And the over-all advanced design assures you of more and better welds at less cost, with a reduction in costly downtime for maintenance and repair. Additional General Electric advantages are described below.

**For more information about** how General Electric engine-driven welders can help you, contact your nearby General Electric Welding Distributor. He is listed in the yellow pages of your telephone book. Write for descriptive bulletin to Section 714-5, General Electric Company, Schenectady 5, New York.

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# PIPE LINE PERSONALS

▸ **F. D. Roesler** has been promoted to administrative assistant in the general superintendent's office of Magnolia Pipe Line Company, Dallas, Texas. Also announced: **R. S. Irwin,** now division clerk in the central division with headquarters in Dallas, and **D. W. Pedigo** to district clerk in the North Texas district with headquarters in Wichita Falls, Texas.

▸ New members of The Pipe Liners Club of Tulsa, Tulsa, Oklahoma, are: **H. Sam Aubrey,** W. C. Myers Company; **J. Marston Linehan,** Mid-Continent Pipe Line Company; **Glen E. Michael,** Service Pipe Line Company, and **I. F. Siebert,** Mid-Continent Pipe Line Company.

▸ **Harry D. Hancock** has been elected president of Cities Service Gas Company to succeed **Glenn W. Clark,** who recently resigned to accept the presidency of Mississippi River Fuel Corporation. The board of directors also created the new post of executive vice president, to which **Kirby E. Crenshaw** was elected.

H. D. Hancock

K. E. Crenshaw

Hancock has been manager of the natural gas department of Cities Service Petroleum, Inc., with headquarters in New York, and is widely known for his work related to the development of high-pressure, large-diameter pipe lines for long-distance transportation of natural gas. He received the American Gas Association Distinguished Service Award in 1947 and its Award of Merit in 1953.

Crenshaw has been vice president of Gas Advisers, Inc., a Cities Service subsidiary. He also was vice president and director of Kansas Gas Supply Corporation and a director of Dominion Natural Gas Company, Ltd.

▸ **Lonnie W. Wege,** Missouri attorney, has been named to the position of assistant manager, industrial relations, Cities Service Gas Company, Oklahoma City. Wege fills the vacancy left by the transfer last July of **R. E. Hill** to Petroleum Chemicals, Inc., at New Orleans. Wege was a practicing attorney at Mound City, Missouri, at the time of his new appointment.

▸ **James E. Beck** has been named process engineer in the compressor department of Northern Natural Gas Company. Beck has been with Northern since 1951 and has worked as construction engineer and chief inspector at various locations throughout the system area of Northern and its subsidiary, Permian Basin Pipeline Company. Prior to his recent promotion he was assistant superintendent of the company's Hobbs, New Mexico, compressor station and gasoline plant facilities.

He will be headquartered in Omaha, Nebraska.



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|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7.0 | 7.5 | 8.0 | 8.5 | 9.0 | 9.5 | 10.0 | 10.5 | 11.0 | 11.5 | 12.0 and over |
| 200 | .70 | .75 | .80 | .84 | .87 | .91 | .93 | .96 | .98 | 1.00 | 1.02 |
| 400 | 1.23 | 1.33 | 1.42 | 1.50 | 1.57 | 1.63 | 1.69 | 1.74 | 1.79 | 1.83 | 1.87 |
| 600 | 1.68 | 1.84 | 1.97 | 2.09 | 2.20 | 2.29 | 2.38 | 2.45 | 2.52 | 2.59 | 2.65 |
| 800 | 2.10 | 2.31 | 2.49 | 2.64 | 2.78 | 2.91 | 3.02 | 3.13 | 3.22 | 3.31 | 3.38 |
| 1000 | 2.48 | 2.74 | 2.96 | 3.16 | 3.34 | 3.49 | 3.64 | 3.76 | 3.88 | 3.99 | 4.09 |
| 1200 | 2.83 | 3.14 | 3.41 | 3.65 | 3.86 | 4.05 | 4.22 | 4.37 | 4.51 | 4.64 | 4.76 |
| 1400 | 3.15 | 3.51 | 3.83 | 4.10 | 4.35 | 4.57 | 4.77 | 4.95 | 5.11 | 5.26 | 5.40 |
| 1600 | 3.44 | 3.85 | 4.21 | 4.53 | 4.81 | 5.06 | 5.29 | 5.50 | 5.68 | 5.85 | 6.01 |
| 1800 | 3.71 | 4.17 | 4.57 | 4.93 | 5.25 | 5.53 | 5.79 | 6.02 | 6.23 | 6.42 | 6.59 |
| 2000 | 3.94 | 4.45 | 4.90 | 5.30 | 5.65 | 5.97 | 6.25 | 6.51 | 6.74 | 6.95 | 7.15 |
| 2200 | 4.15 | 4.71 | 5.21 | 5.64 | 6.03 | 6.38 | 6.69 | 6.97 | 7.23 | 7.46 | 7.68 |
| 2400 | 4.32 | 4.94 | 5.48 | 5.95 | 6.37 | 6.75 | 7.09 | 7.40 | 7.68 | 7.94 | 8.17 |
| 2600 | 4.46 | 5.13 | 5.71 | 6.23 | 6.69 | 7.10 | 7.47 | 7.80 | 8.10 | 8.38 | 8.63 |
| 2800 | 4.57 | 5.29 | 5.92 | 6.47 | 6.97 | 7.41 | 7.80 | 8.16 | 8.49 | 8.79 | 9.06 |
| 3000 | 4.64 | 5.41 | 6.09 | 6.68 | 7.21 | 7.68 | 8.11 | 8.49 | 8.84 | 9.16 | 9.46 |
| 3200 | 4.68 | 5.50 | 6.22 | 6.86 | 7.42 | 7.92 | 8.38 | 8.79 | 9.16 | 9.50 | 9.82 |
| 3400 | 4.68 | 5.55 | 6.32 | 6.99 | 7.59 | 8.13 | 8.61 | 9.05 | 9.44 | 9.80 | 10.1 |
| 3600 | 4.64 | 5.57 | 6.37 | 7.09 | 7.72 | 8.29 | 8.80 | 9.26 | 9.68 | 10.1 | 10.4 |
| 3800 | 4.56 | 5.54 | 6.39 | 7.14 | 7.81 | 8.41 | 8.95 | 9.44 | 9.88 | 10.3 | 10.7 |
| 4000 | 4.44 | 5.46 | 6.36 | 7.16 | 7.86 | 8.49 | 9.06 | 9.57 | 10.0 | 10.5 | 10.9 |
| 4200 | 4.27 | 5.35 | 6.29 | 7.12 | 7.86 | 8.52 | 9.12 | 9.66 | 10.1 | 10.6 | 11.0 |
| 4400 | 4.06 | 5.19 | 6.18 | 7.05 | 7.82 | 8.52 | 9.14 | 9.71 | 10.2 | 10.7 | 11.1 |
| 4600 | 3.79 | 4.97 | 6.01 | 6.92 | 7.73 | 8.45 | 9.10 | 9.70 | 10.2 | 10.7 | 11.2 |
| 4800 | 3.48 | 4.71 | 5.79 | 6.74 | 7.59 | 8.34 | 9.02 | 9.64 | 10.2 | 10.7 | 11.2 |
| 5000 | 3.12 | 4.40 | 5.52 | 6.51 | 7.39 | 8.18 | 8.89 | 9.53 | 10.1 | 10.6 | 11.1 |
| 5200 | 2.70 | 4.03 | 5.20 | 6.23 | 7.15 | 7.97 | 8.70 | 9.37 | 9.98 | 10.5 | 11.0 |
| 5400 | 2.23 | 3.61 | 4.82 | 5.89 | 6.85 | 7.70 | 8.46 | 9.16 | 9.78 | 10.4 | 10.9 |
| 5600 | 1.69 | 3.13 | 4.39 | 5.50 | 6.49 | 7.37 | 8.16 | 8.88 | 9.53 | 10.1 | 10.7 |
| 5800 | 1.11 | 2.59 | 3.90 | 5.05 | 6.07 | 6.98 | 7.80 | 8.55 | 9.22 | 9.84 | 10.4 |
| 6000 | .45 | 1.99 | 3.34 | 4.53 | 5.59 | 6.53 | 7.38 | 8.15 | 8.85 | 9.49 | 10.1 |

### PREMIUM QUALITY

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|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | .92 | 1.00 | 1.06 | 1.12 | 1.17 | 1.22 | 1.26 | 1.29 | 1.33 | 1.36 | 1.39 |
| 400 | 1.60 | 1.75 | 1.88 | 1.99 | 2.09 | 2.18 | 2.26 | 2.34 | 2.41 | 2.47 | 2.52 |
| 600 | 2.19 | 2.41 | 2.60 | 2.77 | 2.93 | 3.06 | 3.19 | 3.30 | 3.40 | 3.49 | 3.57 |
| 800 | 2.72 | 3.01 | 3.27 | 3.50 | 3.70 | 3.89 | 4.05 | 4.20 | 4.33 | 4.45 | 4.57 |
| 1000 | 3.21 | 3.58 | 3.90 | 4.18 | 4.44 | 4.66 | 4.87 | 5.05 | 5.22 | 5.38 | 5.52 |
| 1200 | 3.65 | 4.10 | 4.48 | 4.83 | 5.13 | 5.40 | 5.65 | 5.87 | 6.07 | 6.26 | 6.43 |
| 1400 | 4.06 | 4.58 | 5.03 | 5.43 | 5.79 | 6.11 | 6.39 | 6.65 | 6.89 | 7.10 | 7.30 |
| 1600 | 4.44 | 5.03 | 5.55 | 6.01 | 6.41 | 6.78 | 7.10 | 7.40 | 7.67 | 7.91 | 8.14 |
| 1800 | 4.79 | 5.45 | 6.03 | 6.55 | 7.00 | 7.41 | 7.78 | 8.11 | 8.42 | 8.69 | 8.95 |
| 2000 | 5.10 | 5.84 | 6.48 | 7.05 | 7.56 | 8.02 | 8.42 | 8.79 | 9.13 | 9.44 | 9.72 |
| 2200 | 5.38 | 6.19 | 6.90 | 7.53 | 8.09 | 8.59 | 9.04 | 9.45 | 9.82 | 10.2 | 10.5 |
| 2400 | 5.62 | 6.51 | 7.28 | 7.97 | 8.58 | 9.12 | 9.61 | 10.1 | 10.5 | 10.8 | 11.2 |
| 2600 | 5.83 | 6.79 | 7.63 | 8.37 | 9.03 | 9.62 | 10.2 | 10.6 | 11.1 | 11.5 | 11.8 |
| 2800 | 6.00 | 7.03 | 7.94 | 8.74 | 9.45 | 10.1 | 10.7 | 11.2 | 11.6 | 12.1 | 12.5 |
| 3000 | 6.13 | 7.24 | 8.21 | 9.07 | 9.83 | 10.5 | 11.1 | 11.7 | 12.2 | 12.6 | 13.1 |
| 3200 | 6.23 | 7.41 | 8.45 | 9.36 | 10.2 | 10.9 | 11.5 | 12.1 | 12.7 | 13.2 | 13.6 |
| 3400 | 6.29 | 7.54 | 8.64 | 9.61 | 10.5 | 11.2 | 11.9 | 12.6 | 13.1 | 13.7 | 14.1 |
| 3600 | 6.30 | 7.63 | 8.80 | 9.82 | 10.7 | 11.6 | 12.3 | 13.0 | 13.6 | 14.1 | 14.6 |
| 3800 | 6.27 | 7.68 | 8.91 | 9.99 | 11.0 | 11.8 | 12.6 | 13.3 | 13.9 | 14.5 | 15.1 |
| 4000 | 6.20 | 7.68 | 8.97 | 10.1 | 11.1 | 12.0 | 12.9 | 13.6 | 14.3 | 14.9 | 15.4 |
| 4200 | 6.08 | 7.63 | 8.99 | 10.2 | 11.3 | 12.2 | 13.1 | 13.8 | 14.5 | 15.2 | 15.8 |
| 4400 | 5.92 | 7.55 | 8.97 | 10.2 | 11.3 | 12.3 | 13.2 | 14.1 | 14.8 | 15.5 | 16.1 |
| 4600 | 5.70 | 7.40 | 8.88 | 10.2 | 11.4 | 12.4 | 13.3 | 14.2 | 15.0 | 15.7 | 16.3 |
| 4800 | 5.43 | 7.20 | 8.75 | 10.1 | 11.3 | 12.4 | 13.4 | 14.3 | 15.1 | 15.8 | 16.5 |
| 5000 | 5.10 | 6.95 | 8.57 | 10.0 | 11.3 | 12.4 | 13.4 | 14.3 | 15.2 | 16.0 | 16.7 |
| 5200 | 4.73 | 6.65 | 8.33 | 9.82 | 11.1 | 12.3 | 13.4 | 14.3 | 15.2 | 16.0 | 16.7 |
| 5400 | 4.30 | 6.29 | 8.04 | 9.58 | 11.0 | 12.2 | 13.3 | 14.3 | 15.2 | 16.0 | 16.8 |
| 5600 | 3.80 | 5.87 | 7.69 | 9.28 | 10.7 | 12.0 | 13.1 | 14.2 | 15.1 | 16.0 | 16.7 |
| 5800 | 3.25 | 5.40 | 7.27 | 8.93 | 10.4 | 11.7 | 12.9 | 14.0 | 14.9 | 15.8 | 16.7 |
| 6000 | 2.64 | 4.86 | 6.80 | 8.51 | 10.0 | 11.4 | 12.6 | 13.7 | 14.7 | 15.7 | 16.5 |

By Permission of The Multiple V-Belt Drive & Mechanical Power Transmission Association and The Rubber Manufacturers Association.

Notes: 1. Some of the smaller $d_e$ values shown above are obtainable only with sheave diameters smaller than the minimum recommended in Table 1. Ratings for such small equivalent diameters are given in case it is necessary to use diameters smaller than the recommended minimum.
2. Belt speed is figured using the pitch diameter and R.P.M. of one of the sheaves on the drive.
3. If belt speeds are over 5000 feet per minute the sheaves may require special construction or special material. They may also require dynamic balancing. Such applications should be referred to the manufacturer.

CUT ALONG THIS LINE FOR YOUR PERSONAL REFERENCE FILE.

# NEW Pipe Line Equipment

• machinery • supplies • services

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers

**(81) Pulse Code Telemetering System Equipped with Servo-Writer.** When it is essential to maintain close control of the flow of petroleum products, "Varec" not only supplies remote liquid-level telemetering and supervisory controls but can handle data recording at predetermined intervals.

This additional function has been made possible by supplementing the "Varec" Pulse Code Receiver with converter equipment to operate a solenoid-actuated typewriter unit. Data are logged to permit accurate inventory control, and the printed report can be used by the accounting department.

*The Vapor Recovery Systems Company.*

**(82) Air Compressor Lubricant.** A synthetic lubricant for air compressors which minimizes explosions and receiver fires as well as carbon deposits on exhaust valves and air system piping has been announced by Monsanto Chemical's organic chemicals division.

Trademarked Pydraul AC, the lubricant is described by Monsanto as a fire-resistant fluid equivalent in lubricity to a premium-grade lube oil. Quite similar in its properties to the company's other Pydraul fire-resistant fluids, it is reportedly unique in its marked ability to reduce carbon deposition, thus offering important maintenance savings in addition to a wide safety margin in compressed air systems.

*Monsanto Chemical Company.*

**(84) Hydraulic Truck-Mounted Crane.** Truck-mounted crane, the Versa-Lift Model 400, has been placed in production. Crane mounts on any truck, from 1½ tons up, and will lift from 3500 to 7000 lb. Unit is completely hydraulic and powered by direct PTG-driven hydraulic pump.

*Teale & Company.*

**(85) Bearing Temperature Monitor.** A multi-point bearing monitor, providing centralized and automatic temperature protection for bearings in large, stationary machinery installations, is announced.

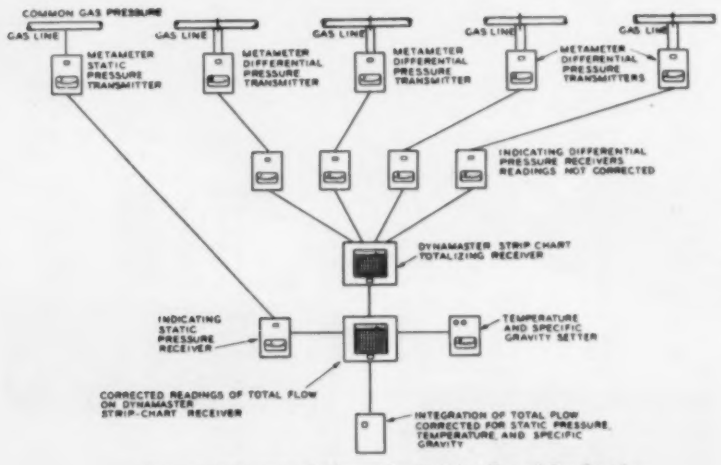
Controller is especially designed for use with such installations as diesel engines, stand-by electric generators, and petroleum pipe line pumping equipment.

*Tipp-Tronic, Inc.*

**(86) High-Power Tractor Line.** Euclid Division of General Motors has announced two crawler tractors, the Model C-6 and the improved Twin Power TC-12.

Model TC-12 is powered by two 218-hp GM 6-71 engines. Each engine drives one of the tracks through torque converter and semi-automatic transmission. Twin Power design makes each half of the tractor practically a separate unit. Model C-6 Crawler has a 218-hp GM engine with 208 hp delivered to the power train through an Allison Torqmatic Drive.

*Euclid Division of General Motors Corporation.*


COMMON GAS PRESSURE
GAS LINE
METAMETER STATIC PRESSURE TRANSMITTER
METAMETER DIFFERENTIAL PRESSURE TRANSMITTER
METAMETER DIFFERENTIAL PRESSURE TRANSMITTERS
INDICATING DIFFERENTIAL PRESSURE RECEIVERS READINGS NOT CORRECTED
DYNAMASTER STRIP CHART TOTALIZING RECEIVER
INDICATING STATIC PRESSURE RECEIVER
TEMPERATURE AND SPECIFIC GRAVITY SETTER
CORRECTED READINGS OF TOTAL FLOW ON DYNAMASTER STRIP-CHART RECEIVER
INTEGRATION OF TOTAL FLOW CORRECTED FOR STATIC PRESSURE, TEMPERATURE AND SPECIFIC GRAVITY

***Metameter Telemetering Equipment for Totalizing Flow of Gas through a number of pipes, corrected for Pressure, Temperature, and Specific Gravity.***

**(83) Computing Telemetering System.** A new system of telemetering instruments which is designed to totalize several flow measurements, correct for such factors as temperature, pressure, specific gravity, and supercompressibility in fluids, and to provide a corrected flow value, has been announced by Bristol.

This system of telemetering transmitters and receivers, and electronic self-balancing instruments can be used wherever corrected flow valves are vital.

In a typical system, indicating or recording telemeter receivers retransmit the uncorrected flow values to a totalizing electronic instrument. At this stage, corrections for static pressure, temperature and specific gravity are made, either by signals from other Metameter transmitters or by manual settings, and the corrected total is recorded and integrated if desired.

*The Bristol Company.*

**(87) Versatile Moisture Monitor.** Portable, low-cost instrument for accurately measuring minute quantities of moisture in gaseous mixtures is now available.

Called the Type 26-301 Moisture Monitor, it is expected to solve many problems encountered in pipe line operations, quality control, and process efficiency. It will measure water content accurately down to 1 ppm, and permit precise meter readings over the full-scale range of 0 to 1000 ppm. Output of the analyzer can be telemetered to a remote recorder for monitoring or control.

*Consolidated Electrodynamics Corporation.*

**(88) Handwheel Operator for Cylinder Actuators.** "Cono-Clutch" handwheel operator is available from Conoflow as an integrally mounted accessory for the company's standard line of Cylinder Conomotor actuators.

The "Cono-Clutch" hand operator affords immediate manual control in the event of air failure. It can be instantly thrown in and out of gear at any position of the stem travel. Clutching and declutching are accomplished simply by pulling or pushing a knob conveniently located on the face of the unit.

*Conoflow Corporation.*

**(89) Corrosion-Resistant Entrainment Separator.** Separator for the removal of liquid particles from air and other gases has been developed by National Carbon.

An impingement-type separator made of "Karbate" impervious graphite, the type MV scrubber is a compact, self-contained unit ready for inserting in a pipe line.

At a pressure of 1 atm, the scrubber is designed for gas approach velocity of approximately 30 fps, at which the pressure drop is less than 1 in. (water column). At velocities twice those designed for, reentrainment occurs, but is retarded by the tear-drop cross-section of the separator rods.

*National Carbon Company, division of Union Carbide and Carbon Corporation.*

**(90) Dual Drill Rig Available with Heavy Feed.** A self-propelled dual drill rig with one of the most variable drilling patterns yet attained is being marketed by the Le Roi Division of Westinghouse Air Brake.

The drill, the T286, is designed for fast drilling speeds in hard formations and easy maneuverability over rough terrain. Rig may be purchased with one or two Le Roi-Cleveland air feeds mounted on a crawler tractor powered with a 28-hp gasoline engine.

*Le Roi Division, Westinghouse Air Brake Company.*

**(91) PVC Expansion Joint.** The first slip-type expansion joint of unplasticized polyvinyl chloride, according to the manufacturer, has been introduced by Tube Turns Plastics.

Expansion joint is made in 1-in., 2-in., and 3-in., sizes, and may be used with piping of smaller diameters by employing reducing bushings. All sizes allow an expansion of 3¾ in.

Joint is designed for use with rigidly fixed PVC piping subjected to thermal cycles. It has a neoprene "O" ring packing and is suitable for a wide range of corrosive services. Joint has been tested at pressures up to 325 psi and temperatures up to 140F.

*Tube Turns Plastics, Inc.*

**(92) Automatic Dry Chemical Fire System.** A compact, low-cost, automatic dry-chemical fire extinguishing system for flammable liquid, electrical, and textile fire hazards has been developed by Ansul Chemical.

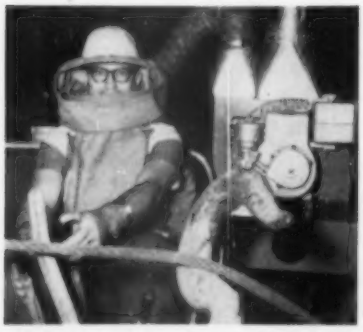
The 30-lb piped system (PS-30) can be operated either automatically or manually. It is intended primarily for protection of moderately-sized hazards.

Extinguisher consists of a 30-lb capacity dry chemical unit installed near the hazard and serving as a storage tank for the dry chemical. A special $CO_2$ gas pressure cartridge furnishes pressure to expel the dry chemical onto the fire through piping connecting the dry chemical unit with the hazard area.

*Ansul Chemical Company.*

**(93) Dust-Shielding Device.** Newest device to insure safety and efficiency is a novel dust-shielding device devised by Jim Cummings of Crutcher-Rolfs-Cummings.

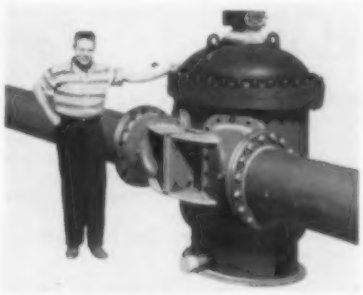
Called "Dust Hood," equipment is designed for the protection of tractor drivers,



dope machine operators, ditcher crews, and other personnel whose jobs require exposure to capricious weather. Unit consists of a 1½ hp gasoline engine, two screen filters, air tube, and an open-windowed helmet.

*Crutcher-Rolfs-Cummings, Inc.*

**(94) High Volume Oil Meter.** The largest rotary positive displacement petroleum meter known has been manufactured by



A. O. Smith. With a capacity of 10,000 bbl per hr, Model B-700 meter is designed to speed tanker loading, line flow rate, and other large-capacity streams requiring precise measurement. Meter is temperature compensated and equipped with gravity selection. It utilizes a 16-in. dual case.

*A. O. Smith Corporation.*

**(95) Blast-Hole Drill Unit.** Drill unit was designed specifically for highway, pipe line, and other types of construction projects where continuous blasting or drilling is needed.

Damco Blastholer is a self-propelled, rotary unit. Eleven-foot holes have been cut in 20 sec and the rig moved to the next location ready for drilling in 1½ min. The compressor, an integral part of the Blastholer, is used for blowing the hole.

*Drilling Accessory & Manufacturing Co., Inc.*

**(96) Miniature Turbulence Gage.** Designed to measure turbulent pressures along skin surfaces of model structures, for the study of fluid flow in gas and hydraulic lines, and in microphone applications, the new Endevco Turbulence Gage provides 40 mv sensitivity per psi minimum with a pressure range of 0 to 10 psi.

Endevco Model 2503 Gage is ⅜ in. diam by ¼ in. thick and may be flush mounted with wax, 0 rings, or retaining rings. Rigid mounting is not required.

*Endevco Corporation.*

**(97) Pocket-Size pH Meter.** A versatile, low-priced, pocket-size pH meter for acidity and alkalinity measurements that is claimed to be accurate, dependable, easy-to-operate and uses a combination electrode is in production by the scientific instruments division of Beckman Instruments.

Range of the meter is from 2 to 12 pH. The single electrode combines both the reference and glass electrodes and has been especially developed for use with the new "Pocket pH Meter." The instrument also has a "memory" dial for use in standardizing.

*Beckman Instruments, Inc.*

**(98) Coaxial Transmission Line.** Availability of 6⅛-in. 50 ohm coaxial transmission line for high-power, low-loss military and commercial services has been announced by Prodelin.

Built in accordance with Retma Standard TR-134, Prodelin pin-type, reactance-compensated Teflon insulators provide constant impedance and broadband characteristics.

*Prodelin, Inc.*

**(99) Pipe Wrap.** Tape extruded of Tenite polyethylene is an advanced modern medium for impeding pipe corrosion.

The polyethylene material Safe-T-Clad tape permits little or no moisture absorption or penetration. It resists electrolytic attack and microbiological deterioration, and does not leach out when buried in the earth.

Users are the petroleum industry, utilities companies, bleacheries, soap and detergent manufacturers, chemical companies, platers, and the plumbing trade.

*Eastman Chemical Products, Inc.*

**(100) Gas Dehydrator.** A gas dehydration unit featuring the use of calcium chloride pellets in a tower of patented design has been put into production by the manufacturing division of Fish Engineering.

Tests are said to have proved the dehydrator removes from 3.5 to 5 lb of water per pound of $CaCl_2$ — which is from two to three times the normal removal.

There is no maintenance required aside from reloading the desiccant and changing of charts. Field tests have shown the unit will depress the dew point from 75 to 100 deg. Freeze-ups are prevented with temperatures ranging down to minus 60F. The equipment operates at wellhead pressure, this ordinarily eliminating the presence of free oxygen which promotes corrosion.

Fish Engineering is now producing four models of the dehydrator, ranging from 2500 MCF per day with working pressure of 990 to 5000 MCF a day with designed working pressure of 660.

*Fish Engineering Corporation.*

**(9) Teflon-Sealed Orifice Plate.** Daniel Orifice Fitting has developed an orifice plate sealing unit from Teflon.

Designed for use in Daniel Senior and Junior Fittings and Simplex Plate Holders, this seal unit is claimed to give perfect seal on both orifice plate and fitting seat.

The "TS" seal is a simple, two-piece unit that locks securely around the orifice plate with ring clips, and is recessed to receive Daniel Catalog 500 Orifice Plate. The plate can be removed by hand pressure alone.

*Daniel Orifice Fitting Company.*

**(101) Backhoe-Loader Combination.** According to information received from the International Harvester Company, Shawnee Manufacturing has announced that Loadmaster Loader Model LM-3A and Model D-90 "Chief" Backhoe have been tested and approved for mounting on the I-HW-400 industrial tractor.

The Loadmaster lifts 3500 lb to 9 ft dumping height. The "Chief" backhoe digs efficiently to 14 ft deep with an actual reach below surface of 15 ft.

*Shawnee Manufacturing Company, Inc.*

**(102) Fixed-Range Differential Pressure Transmitter.** Taylor Instrument has introduced a new concept in low-cost flow transmission.

Unchecked sources of steam, water, and air in departmental consumption can now be easily and economically cost-accounted with the 200TD Fixed-Range Differential Transmitter.

Unit is inexpensive by comparison and is used for liquid level, consistency, or low-pressure air or gas (up to 10 psi) control requiring sensitive transmission readings to an indicating or recording instrument.

*Taylor Instrument Companies.*

# NEW Literature

**For more information on items described here in brief, use the handy reply card and circle the corresponding numbers**

**(103) Flexible Couplings.** Torsionally flexible, Morflex couplings are fully described in a new 24-page catalog. Complete dimensions and specifications are given on standard, double and radial-type couplings with additional data on coupling driveshafts.

*Morse Chain Company.*

**(104) Improved Trenchliner Design.** Featuring a 25 per cent increase in digging capacity, Parsons has announced publication of a new catalog describing the improved Model 155 Trenchliner. A ladder-type machine, the 155 can dig to a maximum 10-ft depth, in widths of 16 to 26 in.

*Parsons Company, a division of Koehring Company.*

**(105) Power Crane and Excavator.** A new 4-page illustrated bulletin, describing the crawler-mounted Model C-35 Bantam, has been announced by Schield Bantam. Bulletin contains detailed information concerning the latest specifications, features, capacities, and application data for the company's crawler-mounted ⅜-cu yd, 5-ton crane-excavator model.

*Schield Bantam Company.*

**(106) Welding Chart.** A new "Selec-Tic" welding shop wall chart (TIS 2616) of 150 Eutectic "Low-Temperature Welding Alloys" is now available from Eutectic Welding Alloys. The two-color chart lists torch and arc welding applications for cast iron, copper and copper alloys, stainless steels, nickel and nickel alloys, aluminum, impact, wear and corrosion-resistant overlays and for metal-working job.

*Eutectic Welding Alloys Corporation.*

**(107) Pump Bulletin.** Dorr-Oliver announces publication of a new, two-color, 20-page, general bulletin, "Application Engineered," detailing the complete line of Dorr-Oliver pumps available to industry. It describes the distinctive characteristics, materials of construction, types, sizes and capacities of the six major types of Dorr-Oliver pumps for the chemical process and related industries.

*Dorr-Oliver Incorporated.*

**(108) Plastic Properties.** To help designers, engineers, and fabricators choose the right plastic for any job, a revised 1957 edition of the "Condensed Reference File of Bakelite Plastics" has been published by Bakelite.

Distinguishing characteristics, appropriate fabricating techniques, and major fields of application are clearly defined for each different group of plastics in a terse, fact-packed style.

*Bakelite Company, a division of Union Carbide and Carbon Corporation.*

**(109) Inorganic Zinc Coating.** Amercoat's inorganic zinc coating for tank interiors and exteriors, towers, structural steel, piping, and offshore equipment is described in a new 4-page, illustrated brochure giving general, physical, and chemical properties of Dimetcote.

*Amercoat Corporation.*

**(110) Motor Selector.** A new 12-page Reliance Motor Selector, published by Reliance Electric and Engineering, gives full information on how to select a-c motors for specific applications. Two pages are devoted to a pictorial glossary of motor enclosure terminology.

*Reliance Electric and Engineering Company.*

**(111) Corrosion Control with Tape.** A new, 8-page, illustrated booklet describes the advantages of Trantex Poly Vinyl Tape for covering and protecting pipes, valves, frames, racks, and metal surfaces against corrosion both above and below ground.

Descriptive text, drawings, and photos provide practical information to help users determine their own applications for Trantex corrosion control tapes.

*Dutch Brand Division of Johns-Manville.*

**(112) General-Purpose Control Operation and Application Manual.** Thirty-two page, illustrated publication explains what each product is, shows how the product works, and tells where the devices can be applied.

*General Electric Company.*

**(113) Lubricating Plug Valves.** New 28-page catalog shows 100 per cent pipe area, venturi, round-port, and diamond-port Homestead Lubricated Plug Valves in a variety of metals for 150-lb steam working pressure, 200 lb oil-water-gas, and A.S.A. 150 and 300-lb classes.

Complete with engineering dimensions, this catalog also shows different types of power operators for valves, in addition to complete lines of lever-operated and worm and gear-operated valves.

*Homestead Valve Manufacturing Company.*

**(114) Variable Speed Drives.** Motor drives with positive pulley adjustment, ranging from ½ to 25 hp, are the subject of an 8-page bulletin offered by Worthington.

Bulletin contains complete information on how to select variable speed drives to meet any specialized requirement.

Equipped with mounted hand-wheel for fingertip speed control, Worthington Motor Drives are available with explosion-proof motors and can be mounted on the floor, wall, or ceiling. The Worthington Motor Drive features positively adjusted variable pitch pulleys and is claimed to meet all requirements for smooth, uniform power, and accurately maintained speed under all conditions.

*Worthington Corporation.*

**(115) Speed Reducers.** A booklet entitled "Speed Reducer Engineering Manual" is available from Westinghouse. Manual presents complete application information such as horsepower ratings, torque capacity, overhung load values, dimensions, construction features, installation and maintenance for single, double and triple reduction. Speed reducers may be driven by electric motors, gas, oil, or diesel engines.

*Westinghouse Electric Corporation.*

**(116) Sidecrane-Backfiller-Tamper.** The Cleveland 80W is the subject of a new 12-page, two-color bulletin. A fast, efficient backfiller, the one-man-operated 80W is also a highly usable pipelayer and sidecrane with a 30,000 ft-lb capacity.

*The Cleveland Trencher Company.*

**(117) Temperature Controls.** A 6-page catalog describes the complete line of Thermoswitch temperature controls of Fenwal.

Literature gives physical specifications, performance data, temperature ranges and other pertinent information about these precision theromstats.

Also listed and described are the various modifications and special features, such as moisture-proof seals, armored cable, extended shell, temperature-setting knob and dial, etc., which can be supplied to adapt the Thermoswitch to varied service requirements.

*Fenwal Incorporated.*

**(118) Forging and Casting Division.** A 30-page catalog on the forging and casting division of Allegheny Ludlum is now being distributed by the company.

Catalog gives complete data on smooth hammered forgings, composite die sections, cast-to-shape tool steels, and a new steel finder, which gives detailed information on the various forging and casting steel grades made by this division.

*Allegheny Ludlum Steel Corporation.*

**(119) How American Standards Are Made.** This booklet describes the three ways standards become nationally accepted and approved as American Standards. It tells who makes these American Standards and why, and who uses them.

Also the booklet explains why the American Standards Association exists, how it guards the democratic processes through which American Standards are developed, and how it operates impartially for the manufacturer, the consumer, and the general public.

*American Standards Association.*

**(120) Pipeliner Machine.** Insley Manufacturing has released a 6-page, two-color folder which describes and illustrates the Insley Pipeliner machine.

Folder pictorially illustrates new pipe line design features plus action photos of the machine at work. Working range diagrams, lifting capacity ratings and specification data are also included.

*Insley Manufacturing Corporation.*

**(78) Open Drip-Proof Motor.** Latest design features of Allis-Chalmers open drip-proof motors in NEMA rerated ratings of ½ to 40 hp (Type G) and in non-rerated ratings of ½ to 100 hp (Types AP and APWW) are described in a bulletin released by the company.

New features of the rerated motors include a diagonally split cast iron conduit box for increased accessibility and ease of wiring, leads with attached metal markers and positioned by number for ease in making connections.

*Allis-Chalmers Manufacturing Company.*

**(79) Welding Fittings and Flanges.** A 6-page folder on welding fittings and flanges has been released by the tubular products division of Babcock & Wilcox.

This folder describes briefly but completely the full line of carbon, alloy, and stainless steel seamless welding fittings and forged steel flanges handled by B&W.

*The Babcock & Wilcox Company.*

# When the man-sized perforating shows up

## LANE-WELLS "E-GUN" is the "husky" to handle 'em!

In East Texas, in West Texas, in all parts of the Gulf Coast —Lane-Wells "E-Gun" is being kept busier than a bird dog. Operators in these areas discovered, some time ago, that the terrific penetration of the "E-Gun" brought in results on the toughest kind of jobs. In fact, they tell us that the "E-Gun" often gets results when nothing else will.

What are these tough jobs? Perforating hard, tight formations, heavy cement sheathes, perforating after squeeze jobs, getting through multiple strings, preparing for acidizing and frac jobs. On all of these, hundreds of times over, the "E-Gun" has proved itself to the point that, now, many operators call for it on *all* their perforating.

The "E-Gun" is a solid bar-stock gun, delivering as many as 50 shots per run, 360° pattern, 6" vertical spacing. Selective firing allows you to call for optimum shot density in any type of job. Available in 4 sizes, from 3-1/4" OD to 5-7/16" OD. And with it you get, of course, the depth measure accuracy and safety for which Lane-Wells has long been noted.

*Tomorrow's Tools - Today!*

LANE WELLS COMPANY

General Offices, Export Office, Plant
5610 So. Soto St., Los Angeles 58

LOS ANGELES • HOUSTON • OKLAHOMA CITY
LANE-WELLS CANADIAN CO. IN CANADA
PETRO-TECH SERVICE CO. IN VENEZUELA

## A RESOLUTION THAT TURNED INTO A HABIT

The old saying, "New Years' Resolutions are only made to be broken", has never been accepted here at Halliburton. It never had a chance! First, because in all the years since Halliburton cemented its first well, we have held steadfastly to but one resolve...one purpose: to aid the recovery and production of oil...with optimum results at minimum costs...with maximum possible protection to untapped reserves...by providing intelligent, effective, integrated services to this end. That Halliburton remains dedicated exclusively to its primary purpose is proof enough that one good resolution...faithfully kept...stands the test of time...and competition. Second, because every year adds stature and strength to a firmly rooted...healthy...still growing *desire* to serve. Good resolutions...firmly guarded and kept...eventually become good habits. And *sincere* service is a habit we intend to keep...and continue to cultivate...to the benefit of every Halliburton customer and the Industry we are proud to serve.

# HALLIBURTON

**OIL WELL CEMENTING COMPANY**

DUNCAN, OKLAHOMA

"PROGRESS IN SERVICE THROUGH RESEARCH"